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a+pc

October 2014
Issue 407

YOUR EXPERT GUIDE TO TODAY'S TECH

BUMPER ISSUE!

BONUS 32-PAGE PC BUILDER'S BIBLE INSIDE

Construct a PC yourself with our complete guide!

UDGET & BEASTLY

ild yourself a 1080p ming PC for $600!
fordable 4K & G-Sync LCDs & the future of PC gaming

ORGET PS4 XBOX ONE

CONSOLE KILLER!

EAT THE CONSOLES WITH LOW-COST GAMING RIG, R OUTCLASS 'EM WITH UTTING EDGE PC TECH!

THE RIFT GETS REALER

First Aussie test of the new Rift VR kit!

PI-POWERED PRIVACY

Use a Raspberry Pi to protect yourself online

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- Browse anonymously on iOS
- Fix Windows PC problems
- Overclock an Intel PC

RUN LINUX ON YOUR ANDROID

Transform an old phone or tablet into a fully-fledged PC!

RATED

iPAD GETS OUTCLASSED?

Is Samsung's new Galaxy the tablet that Android lovers have been waiting for?

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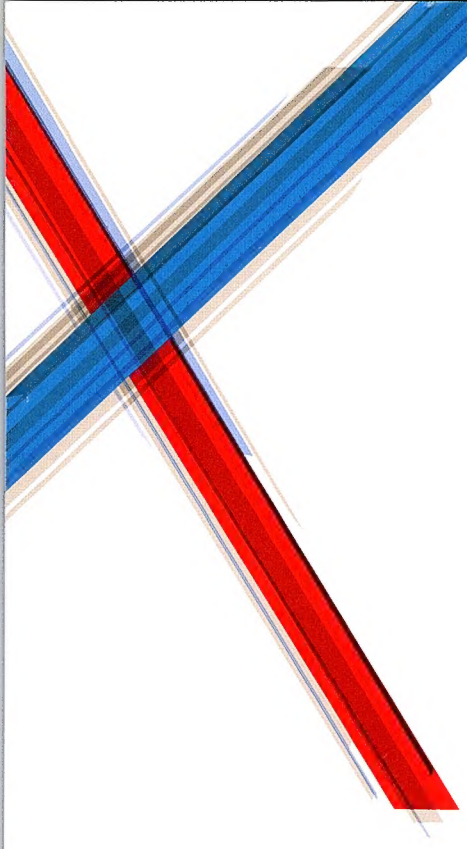


Can a move spark a **transformation?**

See it happen with System x.

You've probably heard that IBM® and Lenovo have entered into a definitive agreement where Lenovo plans to acquire the IBM System x server business[1]. This is big news, and it is natural for clients to have a few concerns. This letter from all of us on the System x team is to assure you, our clients, that this strategic collaboration is a benefit for the industry and especially for you.

Perfect Collaboration

Both IBM and Lenovo are dedicated to a larger vision for x86 systems. IBM has long been a leader in client focused innovation of System x servers and solutions, featuring Intel® Xeon® processors. Lenovo is committed to x86 computing and has a proven record of success, as evidenced by their #1 share position in PCs. By leveraging their strengths in scalability, operational efficiency and a broad channel presence, Lenovo will be able to ensure uninterrupted delivery of the innovative System x servers and solutions that IBM offers today. This will create the winning combination to make System x a leader in the x86 segment.

Working for you. Always.

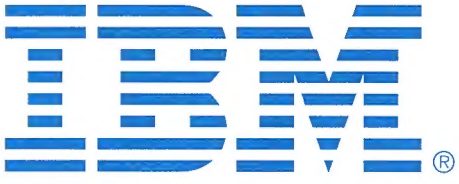
Our respective commitments mean you can continue to rely on getting the performance, reliability, and return on investment you expect for your IT infrastructure. Our team has always been dedicated to delivering exemplary levels of service. We are happy to inform you that IBM will continue to service the System x installed base for an extended period after the transaction closes, so you experience the same quality and accountability that you have come to trust over the years. What's more, we – the 7500 members of the IBM team that delivers System x servers – will continue to do the same, as we will also move to Lenovo.

At IBM, we have always been proud of our ability and commitment to meet the needs of our clients. This announcement opens new avenues for us to expand and improve on this tradition.

Please do visit ibm.com/futureofx/au to learn more about this development.

Sincerely,

The entire System x Team



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FIPP

Why the PC is still the place to be

We'll stick with our PCs for what matters: real work, and bleeding edge gaming.

While a lot of effort has been funnelled into smartphones and tablets recently, the PC has always been the cutting edge when it comes to consumer tech. In a sense, the rise of the smartphone has largely been a case of figuring out how to squeeze 35 years of PC advances into your pocket.

And yet, as successful as that evolution has been, smartphones and tablets still struggle to match a desktop's productivity – and a lot of that comes down to the complexity allowed by the PC's interface. You can have the highest pixel-count in the world on your tablet, but when you're inputting things with your finger those pixels won't do you much good for enhancing precision.

Now, we're far from being console haters here at *APC*, but when it comes to our gaming platform of choice we make no bones about it: PC is the place to be. I have – and will continue to – play FPSs on console. But really, no gamepad can compete with the fine control offered by a mouse for flicking your wrist to do quick a 180, or the precision for pulling off rapid head shots.

Age-old arguments about controls aside, we reckon the PC's still the best choice for gamers for other reasons, too. We've listed a handful at the beginning of this month's cover story (see page 37) but I'd like to add a few more to that list.

I've been lucky enough to be gaming on a 31-inch 4K monitor for the last 6 months or so, jumping up from a 1440p 27-inch screen. It's a boost that's big enough to be noticeable – although it's a little hard to say whether the extra pixels or extra inches are more impressive.

What's perhaps been a little more impactful, though, is the ability to stream games (using Steam's streaming feature) from that desktop rig to my work MacBook. I can plonk the latter down on the kitchen table for quick loot run in *Borderlands 2* and still chat away with my better half on the other side of the table. It's untethered amazing PC gaming, taking it from my desktop to a device that I can basically use anywhere in the house – and on batteries, with a far better runtime than if the game were playing locally, no less.

It goes to show that, as old as gaming on PC may be, it still has the capacity for surprises.

So forget the naysayers who, for years, have been saying PC gaming – and the PC in general – is dying. The reality is far from it. The PC is here to stay, and from where we stand, it's never been better.

DAN GARDINER
EDITOR
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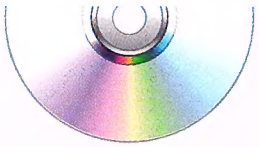

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Find your disc inside on page 67.

technotes

» NEED TO KNOW

Chromebooks are getting more powerful all the time, with Acer's new Chromebook offering Tegra K1 grunt under the hood.

Nvidia's Tegra K1 in a Chromebook?

Acer unveils its first ARM-based Chromebook using an Nvidia Tegra K1 processor.

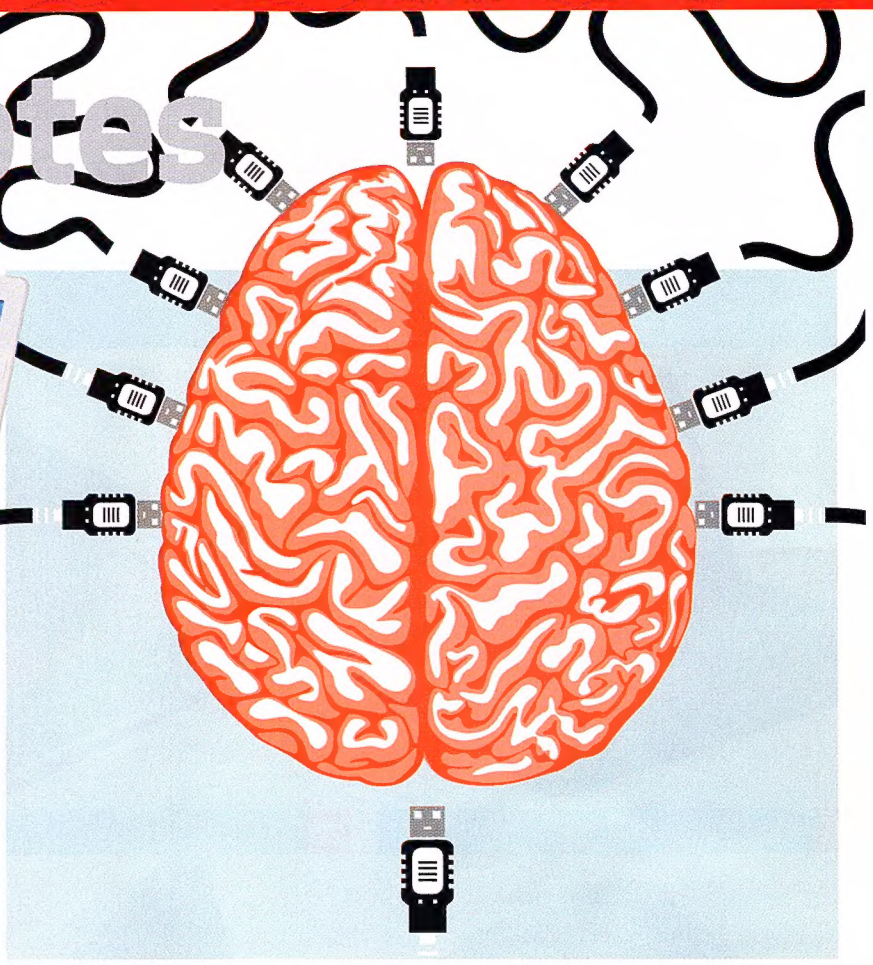
Intel may rule the roost when it comes to Windows and OS X-based laptops, but the company is increasingly facing competition in an unexpected area: Google's Chromebooks.

With ongoing predictions of a booming market for these lightweight laptops, Acer has added to its lineup with the newly announced Acer Chromebook 13, featuring an Nvidia Tegra K1 ARM CPU. Acer has enjoyed previous success in Chromebooks with its well-regarded C720, so the company's first ARM Chromebook with an Nvidia CPU really piques our interest.

The Tegra K1 uses five times less power than the popular Intel Celeron parts used in mobile devices, according to Nvidia, plus has five times the graphics grunt of a Bay Trail-based Celeron N2830 and Exynos 5800-series chip. Nvidia sees the graphics advantage as key. It says the Chromebook 13 is one of the very few that can handle a 10-way Google hangout without the video chunking out.

Australian pricing and availability hasn't yet been announced, but the Acer Chromebook 13 with a 2GB RAM, 16GB of storage, and 1,366 x 768 is expected to sell for US$280. The same Chromebook 13 with a 1,920 x 1,080 screen will cost $20 more, and a version with 4GB of RAM, 1080p panel and 32GB of storage will push it to US$380.

Gordon Mah Ung



New IBM chip modelled on the human brain

Squeezing a million neurons onto a chip the size of a postage stamp can't be easy.

For the last six years, IBM researchers have been looking for a way to bring the power of the human brain to a computer processor, and the project recently hit a significant milestone toward reaching that goal. The IBM Research blog announced a landmark step forward for a "brain-inspired machine" chip funded by DARPA's Systems of Neuromorphic Adaptive Plastic Scalable Electronics (better known as SyNAPSE).

Billed as a "synaptic supercomputer in your palm," the second-generation chip known as TrueNorth "redefines what is possible in the field of brain-inspired computers, in terms of size, architecture, efficiency, scalability, and design techniques."

After accomplishing a modest single-core prototype three years ago, the IBM research team has accomplished the remarkable feat of cramming one million neurons, 256 million synapses and 4,096 parallel cores into a self-contained chip the size of a postage stamp.

Chief Scientist Dr. Dharmendra S. Modha is quick to note that IBM has "not built the brain, or any brain," but rather a computer "inspired by the brain," which for the first time can process sensory data in parallel, much like the human brain itself.

Traditional processors have historically required more energy as they've become faster and more powerful. But TrueNorth reportedly consumes a mere 70 milliwatts of energy, roughly the equivalent to what a hearing aid battery kicks out.

While IBM refers to TrueNorth as a "direction" rather than a "destination," the technology could have huge implications for future devices including smartphones, self-driving automobiles, and even "multimedia processing on the cloud."

For comparison's sake, IBM's first-generation chip was only capable of storing 256 neurons. With one million, scientists hope TrueNorth will lead to computers nearly as powerful as the human brain by the year 2020. Just in time for the iPhone 9... ■ **J.R. Bookwalter**

ATO rules Bitcoin is not money

With some Australian online retailers accepting Bitcoin, along with Bitcoin ATMs popping up around the country, the Australian Taxation Office (ATO) has announced a framework guidance for the tax treatment of the cryptocurrency in Australia.

According to the ATO, there are "no income tax or GST implications for individuals" using Bitcoin if they're not using it for business purposes as it has deemed that "Bitcoin is neither money nor a foreign currency". Instead, the ATO has deemed that the digital currency is an asset, and transacting with the cryptocurrency is similar to a barter transaction. For this reason, the ATO says that Bitcoin transactions should be treated with similar tax consequences.

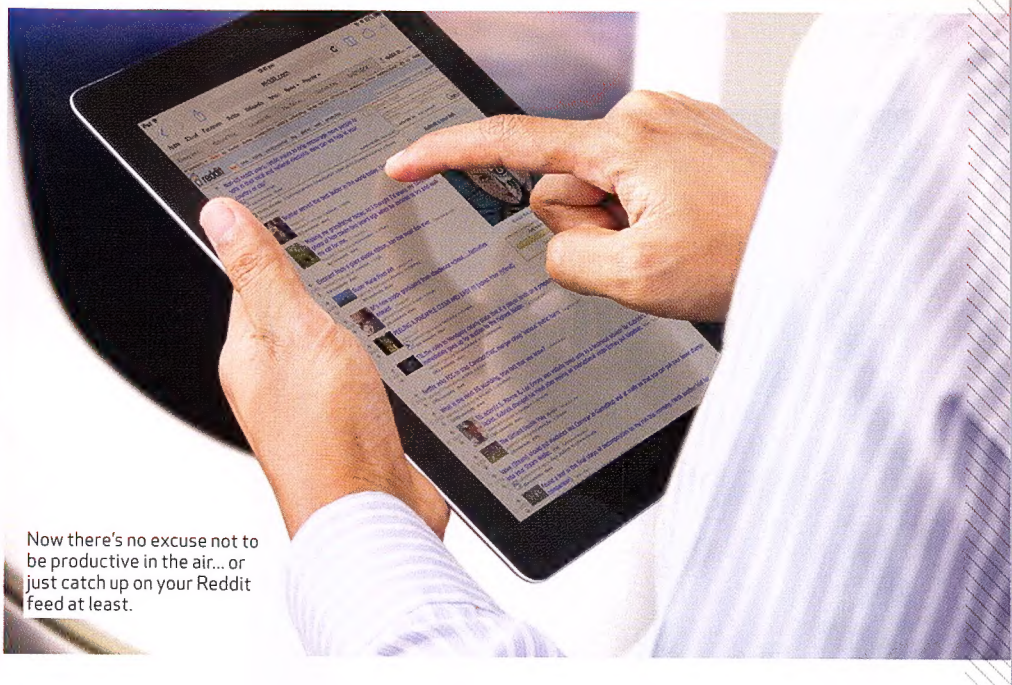
"Where an individual uses Bitcoin to purchase goods or services for personal use or consumption, any capital gain or loss from disposal of the Bitcoin will be disregarded as a personal use asset — provided the cost of the Bitcoin is $10,000 or less." **Farrha Khan**

Google's self-driving cars need to be manual, too

California's Department of Motor Vehicles (DMV) has new regulations that will prevent Google from testing out its self-diving cars on public roads in the US state. As such, Google will need to add physical controls beyond just the start and stop button it currently has before it can be driven, manually or not, on public roads, as the new rules say a driver must be capable of "immediate physical control" of a vehicle.

Google says it will be adding a steering wheel and pedal system for its test vehicles — which currently cannot go faster than 40kmph — with 100 vehicles being made for public road trials.

However, while Google will be obliging to these new regulations, the California DMV is also expected to introduce regulation later this year that will let manufacturers apply for permits to operate driverless cars that have no manual controls (that is, without steering wheels, brakes or accelerators) on public roads. **Farrha Khan**



Now there's no excuse not to be productive in the air... or just catch up on your Reddit feed at least.

Qantas, Virgin Australia travellers can keep their phones on

Flight mode now actually means flight mode.

Virgin Australia and Qantas have been given approval from the Australian Civil Aviation Safety Authority to allow customers to use their personal electronic devices 'gate-to-gate'. This means that travellers can keep their smartphones or tablets on during all phases of the flight, as long as these "personal hand-held electronic devices" weigh less than 1kg. Devices heavier than 1kg, including laptops, will need to be stowed away for take-off and landing. Phones, tablets or any other devices with transmitting signals will need to be switched to "flight mode".

Qantas' approval covers all domestic and international flights, while Virgin Australia's approval covers all domestic flights and some short-haul international services on its Boeing 737, Embraer E190 and Airbus A330 planes. Those on Virgin Australia's regional ATR 72 turboprops and long-haul international Boeing 777-300ERs will still need to turn their phones and tablets off. QantasLink, Jetstar and Virgin Australia New Zealand planes are not approved either. Virgin Australia has said that its other aircraft and fleet will require further testing and approval. ■ **Farrha Khan**

"Qantas' approval covers all domestic and international flights, while Virgin Australia's approval covers all domestic flights and some short-haul international services on its Boeing 737, Embraer E190 and Airbus A330 planes."

1.2 million

Viral charity prank "Ice Bucket Challenge" goes into overdrive with over a million videos.

Facebook has confirmed that more than 1.2 million unique videos of the Ice Bucket Challenge have so far been uploaded to its servers. The Challenge, in which people pour freezing buckets of ice water over their heads before challenging friends to do the same, is intended to raise awareness for ALS (amyotrophic lateral sclerosis, aka Lou Gehrig's disease). Of the many videos by celebrity participants, Bill Gate's effort is one of the most amusing, with his geekily engineered ice-pouring rig sweetly playing up his nerdy rep. Check it out at **tinyurl.com/ms5syrr**.

23 million

Twitter has lots of "active" users, but 23 million of them aren't human.

Twitter has clarified that of its 271 million MAUs (monthly active users), as many as 8.5% of them are accounts automatically accessing the company's servers "without any discernible additional user-initiated action." What does this mean exactly? It's legal geek speak signifying that 23 million Twitter users are actually robots: automated spambots, scrapers and retweeters of one kind or another. So next time you're smugly admiring your billowing follower count, you may want to consider forgoing ~8.5% of said smugness. Unless you're specifically courting robots, that is. In which case, good job and carry on!

#2

Australia ranks second in visiting dodgy malware sites promising free blockbusters.

Is Australia really the lucky country? Not according to a new study by security gurus Trend Micro, which has found that we're the second-most-likely country to respond to social engineering attacks that lure users with the promise of free movies (before tricking them into installing malware-laden software to view the flicks). Australia follows the US as the most affected nation, with India, Malaysia and New Zealand rounding out the top five. Don't click dodgy links, folks! A free copy of the latest Michael Bay film most certainly isn't worth it.

14 years

Fugitive tracked down by facial recognition, living in Nepal 14 years after absconding US.

Facial recognition is advancing at a staggering pace, posing a near future where anonymity may slip from being a threatened luxury to a theoretical impossibility. In the latest demonstration of the reach of the technology, US authorities have tracked down a wanted man 14 years after he went off the grid in New Mexico, locating him working in Nepal as an English teacher under a new name. The FBI found Neil Stammer, wanted on charges of kidnapping and child abuse, after facial recognition matched his mugshot to the passport of Stammer's adopted alter ego, Kevin Hodges.

two billion

Steve Ballmer officially buys Los Angeles' second-most popular basketball team.

What do you do to follow up a 14-year-long stint as CEO of one the world's biggest tech giants? If you're former Microsoft chief Steve Ballmer, you drop a little of your tenure's spoils — amounting to some two billion dollars — on an LA-based NBA team. And by the way, that record-breaking amount won't even fetch you the Lakers. Ballmer successfully outbid other mega-rich folk like David Geffen and Oprah Winfrey to win the LA's other NBA franchise, the Clippers, after former owner, Donald Sterling, was ousted in high controversy after a recording of his racist comments became public.

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technotes

» GEAR WE WANT

POLAROID CUBE

PRE-ORDER FOR US$100 | PHOTOJOJO.COM

Designed as a cute and kitschy competitor to GoPro's portable ruggedised devices, Polaroid's new Cube – a bite-sized digital camera and camcorder that only measures 35mm in any direction – offers a lot to like. It's water-resistant, shock-proof, mountable via an array of accessories and stands – and even magnetised so as to niftily adorn your car bonnet (or fridge). Bonus points for resembling a miniaturised, mobile spawn of 2001's murderous HAL supercomputer. It is 2014, after all. Will ably perform double-duty as a colourful paperweight when not documenting your fun-loving, adventure-seeking outdoorsy lifestyle.

JABRA ROX WIRELESS

$110 | WWW.JABRA.COM.AU

Bluetooth in-ear headphones are typically aimed at exercise use (with sporty designs to match), but Jabra's new Rox buds are more of a general all-rounder. They're still reasonably water and dustproof, so you can wear them while running in the rain, pack a roughly 4-hour listening time (based on our testing) and, perhaps best of all, pack a pleasingly full and energetic sound. If you've been wanting a pair of wireless earbuds, these are our current pick of the bunch when it comes to audio quality. We do wish there was one more set of rubber tips though – our ear canals sit somewhere between the M and L sizes that are included, which made getting a good fit a little tricky.

MOTOROLA MOTO 360

US$249.99 | MOTO360.MOTOROLA.COM

By the time this issue hits the newsstands, Motorola's Android Wear debut, the sizzlingly hot-looking Moto 360, should have officially launched, but an accidental leak on US retail giant Best Buy's web site gave the slip early on previously unannounced specs and pricing for the imminent smartwatch. US$249 will net you a tiny 1.5-inch LCD with 320 x 290 resolution, Texas Instruments CPU, half a gig of RAM, built-in heart monitor and water-proofing to boot. No word yet on when we'll see it in Australia but we'd be surprised if it's not available locally this year. ■

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technotes

EPINIONS

"On top of that after connecting the power cable and micro HDMI port to a digital TV, nothing displayed on the screen. He found the Intel NUC is just a bare bones unit and it does not contain memory, hard disk, OS and device drivers."

NYUCK NYUCK

An article on Intel's NUC in the July edition by Neil Mohr (see page 19) has specified that the pricing of the NUC is a little deceptive as the box is usually sold as bare bones unit. It is indeed a deceptive little box. The device is no doubt good for IT professionals but definitely not suitable for a retail sale as a bare bones unit.

I work in Health Services. One of the Directors impressed by its cute design thought of a brilliant idea and initiated a project to display patient lists on big screens in the hospital wards. After consulting with the IT department, he purchased a few NUCs and wireless keyboards and mice and sent the lot to the IT department to set up and configure. The IT technician found no power cable or power adapter included and it has micro HDMI ports. On top of that after connecting the power cable and micro HDMI port to a digital TV, nothing displayed on the screen. He found the Intel NUC is just a bare bones unit and it does not contain memory, hard disk, OS and device drivers.

When the IT technician informed the concerned authority, the blaming game started in the bureaucratic system until it finally came to its senses and the project went ahead and purchased the required parts (memory, SSD drive, Micro HDMI cable to TV etc). It is now back in the hands of IT technician to finish setting up.

Kiran Manandhar

Ed reply:

There's definitely a hidden cost if you're contemplating a NUC – in fact, you'll basically need to add $100 to the top of the NUC box's price as a starting point. That said, we've seen the Celeron NUC going for as little as $140 locally when on sale, and with SSDs and RAM at reasonably affordable prices, this entry-level NUC could make a neat little PC for the basics, or as a discrete media centre unit.

TIME FOR A BREAK

KitKat on an old PC? Interesting idea, shame it doesn't work. I tried to install it on a hard disk, in my case a spare 32GB SSD, and it stops with an "unsupported GPT (GUID Partition Table) detected" error. It runs off the bootable DVD. It can see the drive to install Android on. It knows how big it is. But it just keeps throwing up the same error even after you have made sure by multiple means that the drive isn't GPT, its MBR. The Linux lot never miss an opportunity to miss an opportunity by making it difficult for anyone to try and use their operating system and its derivatives, instead of just making it work. I'm sure if someone asked them what OOBE stood for they wouldn't know.

Gordon Drennan

APCMAG@FUTURENET.COM

Come on, have your say!

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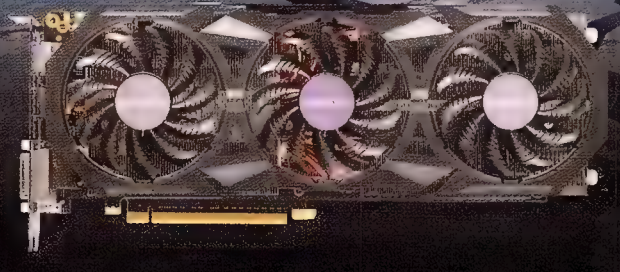
600 WATT OUT



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AMD RADEON GRAPHICS

Scoring an own goal?

User-uploaded videos of football highlights are in the firing line, with the Premier League clamping down on copyright breaches.

Since its inception, YouTube has been a digital treasure trove of sport's glory moments. From sensational slam dunks to amazing surf footage and iconic tennis match-ups, YouTube and other online video sites are a great way of experiencing jaw-dropping athleticism and skill on demand. But the sporting free-for-all of unauthorised video sharing could be under threat. Right off the back of this year's FIFA World Cup in Brazil – the kind of global cultural event that these days thrives through fan participation on innumerable social media channels – the English Premier League has announced that it will be clamping down on fans breaching copyright by uploading videos of goals and other highlights on social media sites.

Dan Johnson, the Premier League's director of communications, told the BBC that fans using services like Twitter and Vine to share and upload videos of broadcast and webcast footage are breaking the law.

The Premier League, which wants to protect its multi-billion dollar deals with official TV and web rights partners, isn't sitting on its hands either, with Johnson telling the BBC: "It's a breach of copyright and we would discourage fans from doing it. We're developing technologies like GIF crawlers, Vine crawlers, working with Twitter to look to curtail this kind of activity. I know it sounds as if we're killjoys, but we have to protect our intellectual property."

KIDTUBE IS IN THE WORKS

Media reports that Google is busy preparing a new signup system letting children under 13 years of age register accounts for child-safe versions of popular Google online services like Gmail and YouTube have caused a stir of controversy, with privacy and children's groups warning the search giant to tread carefully with data collection and other potential legal and regulatory minefields (not to mention moral grey areas). Jeff Chester, executive director with US-based privacy organisation The Centre for Digital Democracy, told the Wall Street Journal: "Unless Google does this right it will threaten the privacy of millions of children and deny parents the ability to make meaningful decisions about who can collect information on their kids."

FLAPPY BIRD REDUX

When Vietnamese game developer Dong Nguyen achieved global success and riches with his simplistic and infuriating 2013 mobile game *Flappy Bird*, he did what almost no software developer would ever think to do. Sensing he had a hit game on his hands, he voluntarily withdrew it from sale, citing that it was simply too addictive and a negative, unhealthy obsession.

Months later, Nguyen is back with *Flappy Bird's* follow-up, *Swing Copters* – which plays almost identically to *FB* save that the player's character now moves vertically instead of horizontally. But will *Swing Copters* prove too addictive like its predecessor? Download it now and see for yourself, but in the words of TouchArcade, which nabbed the first review, *Swing Copters* may again prove too compulsive: "It feels like it's got all the same qualities that made *Flappy Bird* so sticky... Once you see even the smallest bit of success in the game, you can't help but play again, and again, and again..." Careful there, folks! ■

ENDUSER

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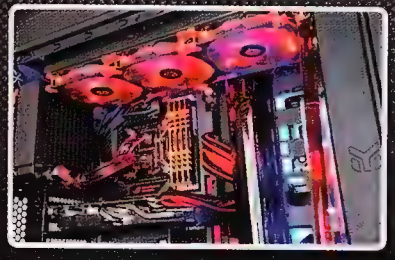

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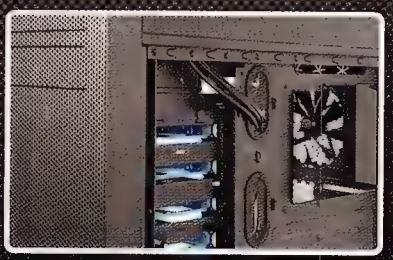

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Razer Blade (2014)

Bleeding edge performance and body, now with a screen to match.

Razer's Blade laptops first appeared back in 2011 and the promise has always been to provide no-compromise Windows-powered gaming machines that match the MacBook Pro for build quality and beat it on performance. And the Blade's have largely lived up to that, although the caveat is that they've always been for the well-heeled – something that won't change any time soon.

For 2014, Razer's offering two Blades – this recently-updated 14-inch model, and a 17.3-inch Blade Pro, released a little earlier in the year. What muddies the waters slightly is that this non-Pro model is actually now better specced than its big brother, with a faster CPU, GPU and higher-res screen. It's the latter that's arguably the biggest change over last-year's 14-inch Blade: this new glossy screen offers touch input at an astounding 3,200 x 1,800-pixels (or 263ppi) putting it a stone's throw from 4K resolution. And it's that res that's ultimately the Blade's best and worst feature.

That resolution is a bit of a mixed blessing for gaming, for example. The Blade's GeForce GTX 870M GPU is actually powerful enough to drive many modern titles at native resolution (with one or two exceptions – *Metro: Last Light* being a notable one), although you'll often need to drop the details down to Medium to manage it. Depending on your outlook, that might completely defeat the purpose and, based on our testing, we'd be more inclined to take the resolution hit and drop the screen back to 1,600 x 900, which means you can turn all the eye candy up to full. We also experienced problems when trying to run games at lower resolutions than native – often they'd be letterboxed, with black borders on all sides. We found you could fix this by dropping to the desired resolution in Windows before launching a game; something that gets annoying fast.

It's also worth noting that Windows 8.1 doesn't co-operate very well with these 'Retina' type resolutions, especially on smaller displays. Microsoft's added better scaling features in its latest OS – which means most native Windows components look fine – but in third-party apps (like Chrome and Steam, for example) the rescaling algorithm often, rather ironically, makes both UI elements and text look fuzzy and soft, rather than the crisp, sharp look you'd want from a display of this pixel density. What's made worse is that, at the suggested default setting, Windows is basically emulating a 1,280 x 720 pixel screen with its scaling, and many apps – even parts of the Windows OS – just aren't made for that low res, resulting in interfaces that are sometimes cropped at the bottom.

It's a shame, because elsewhere the Blade is still a first-rate machine that goes a good way to justifying the price. The metal body is, as always, tough as guts and light weight at 2kg; the chiclet keyboard is nice and stable (though we would have liked a little more height to the keys); and the quad-core Core i7-4702HQ, 8GB of RAM and 256GB Samsung SSD push the Blade along at a very solid clip for non-gaming tasks. So, it's still a killer, no-compromise laptop. But that said, when you're shelling out $3,500, struggling to get the screen to co-operate really shouldn't be part of the deal.

Dan Gardiner

Verdict

Features	★★★★½
Performance	★★★★½
Value	★★★½

Razer's built another impressive bit of hardware here; it' just a pity Windows can't keep up with the high-res display.

★★★★½

apc RECOMMENDS

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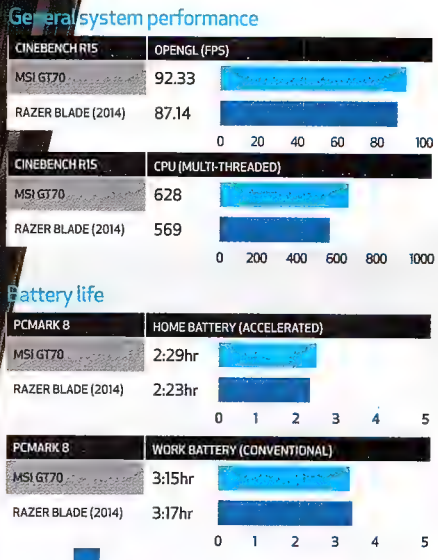

MSI GT70 Dominator

A gaming laptop at the other end of the physical scale.

The two gaming laptops we've reviewed this month are a bit of a stark contrast – there's a definite 'beauty and the beast' thing happening here, with no prizes for guessing which role this 3.7kg MSI model plays. The GT70 design isn't actually new for MSI; it first appeared back in 2012 and this is the second major refresh of what's under the hood (the exact model we tested was the 2PC-1479AU) – although from the outside, it's still an unashamedly big, brash and bulky gaming laptop, with a 17.3-inch 1080p display powered by a GeForce GTX 870M. In fact, the GT70 is about the cheapest laptop with that second-from-the-top Nvidia GPU – it's beaten only by its GS60 Ghost sibling, a smaller and more portable 15-inch gaming laptop that we've reviewed previously (*APC* July, p43).

Internally, there are some definite highlights to the GT70 – the Core i7-4800MQ processor, 8GB DDR3-1600 RAM and GTX 870M (with 3GB of dedicated video memory) do keep games running smoothly at that big screen's native 1080p resolution. And the latter has a matte finish – our preference for gaming, as it reduces reflections and often provides better visibility in darker games. We liked the screen on the whole, but it does carry a slightly red-orange tinge (better for recreating natural skin tones), it's not for colour-accurate work.

You also get a backlit, SteelSeries chiclet keyboard that includes a numpad – and which, yes, is brightly rainbow-coloured by default. For those who might be put off, don't worry – you can turn the colours down or set them to a more-uniformly sedate shade (such as white or blue), or any colour you want really, via an included app for managing keyboard settings. Physically, the keyboard is adequate; it does a respectable job, but the plastic chassis means it's not quite as stable or flex-resistant as you'll get from say, a MacBook or other metal-decked laptop.

Using Qualcomm's Killer LAN devices for Wi-Fi and Gigabit Ethernet networking gives a bit of a mixed result here. While Killer's incorporated QoS features mean that, in theory, you can prioritise your gaming traffic over everything else (allowing for concurrent downloading and gaming, for example), the Wi-Fi is only 802.11n, not the newer standard (and significantly faster in terms of bandwidth) 802.11ac.

There's also no SSD in this entry-level GT70 model – instead, you get a 1TB 7200rpm hard drive for storage. While the latter's as fast as you'll see from a magnetic hard drive, it's no match for an SSD – and it shows in things like boot and game-load times, which can take two or three times longer than we've seen on SSD units.

That said, the battery life was better than we expected from such a big unit – large screens and quad-core processors pull a lot of power – lasting between 2:29hr to 3:15hr in our two benchmarks.

That said, this is about the cheapest you'll find a laptop with Nvidia's GTX 870M GPU in it (and stepping up to the 880M will add another grand or so to the price) and MSI's 2-year pickup and return warranty is one of the best available. While you don't quite get it all in this entry-level GT70 model, at this price, there's enough here to please anyone looking for a beefy gaming laptop without the high price. ■ **Dan Gardiner**

Verdict

Features	★★★½☆
Performance	★★★★☆
Value	★★★★☆

This entry-level GT70 does make some sacrifices, but does enough to be a pleasing gaming package overall.

★★★★☆

The Nightblade is a portable gaming powerhouse.

MSI Nightblade Z97

PCMARK 8	HOME
OVERALL SCORE	4672

0 1000 2000 3000 4000 5000

COMPANY OF HEROES 2	(1080P, MEDIUM DETAIL)
AVERAGE FPS	44.43
LOW FPS	73.63

0 20 40 60 80 100

CINEBENCH R15	SCORE
OPENGL RENDERING (AVERAGE FPS)	145.95
CPU RENDERING	824
CPU RENDERING, SINGLE CORE	165

0 200 400 600 800 1000

X264 HD BENCHMARK 5.01	AVERAGE FPS
1ST PASS	85.52
2ND PASS	17.87

0 20 40 60 80 100

AS SSD	AVERAGE MB/S
SEQUENTIAL READ SPEED	493.2
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MSI Nightblade Z97

The author of this review sharpens his blades in the night. Which might explain the bleeding.

The tagline for the Nightblade intones, "The decisive weapon in the dark..." Presumably this involves clocking someone across the head with the 420 x 285 x 175mm barebones system, as they decisively wouldn't get up afterwards.

This is a gaming box, and hence comes in black and red, because there's no other gaming colours ever, even if once upon a time you might have heard there were, not even green. This gamingness is gamified further by putting red LEDs under the front of the box, and we have to admit that even in our cynical hearts, it looks pretty cool.

The light is switched on when you hit the OC button on the front, giving your CPU and memory speeds up to a 15% boost. Sadly this can't be enabled or disabled at will – you'll need to shutdown your machine before toggling. Tragically, since glowy lights are the only indication it's enabled, it's also impossible to tell which mode you're in until you power up.

A solid handle for carting to LANs is at the bottom, with MSI including a neoprene, velcro-attaching strap that wraps around the handle for extra comfort.

For accessibility, all of the case panels are removable and perforated for air flow except the front and the back. A removable dust filter is on the graphics card side, which faces the floor.

Our particular unit contained a Z97I Gaming AC motherboard, CPU heatsink, slot loading DVD drive, 92mm fan and 600W power supply. MSI may offer a version without a DVD drive and CPU cooler sometime in the future.

Regardless, you'll have to bring your own CPU, RAM and GPU. There's also an extra brace that supports an additional 92 or 120mm fan, extracting straight over the CPU heatsink.

You'll need to keep graphics card clearance in mind – while it can fit a full length card, our custom cooled GTX 670 was too large to close up the case after installation. A 310mm length is fine, but total card height is limited to 40mm.

MSI provides a dual 2.5-inch drive bay, with one already occupied by an expansion card featuring two mini PCI-E slots, intended for storage. Removing this will free up one SATA power connector and two data cables. The card is held in by two quick release plastic rails, of which MSI includes another set in the box.

Under the optical drive is a 3.5-inch bay, with a 3.5-2.5-inch adapter included in the box. Spare cables are slim; once everything is plugged in, you'll only have two SATA power connectors and one SATA data cable to play with, with no four pin power in sight. You do get extra SATA cables in the box, but there's nothing to plug them into with only four SATA connectors available on the motherboard.

While our CPU fan had a bit of an annoying whir and grind to it, at most levels of operation it was decently quiet, with performance falling within the expected Z97 range.

The Nightblade Z97 is a competent offering from MSI, and considering what's included for the price, is worth a look. ■ **Craig Simms**

Verdict

Features	★★★½
Performance	★★★★
Value	★★★★

A respectable gaming box. Little changes could push it to greatness, but in its current form it's good value.

★★★½

Not just a pretty face.

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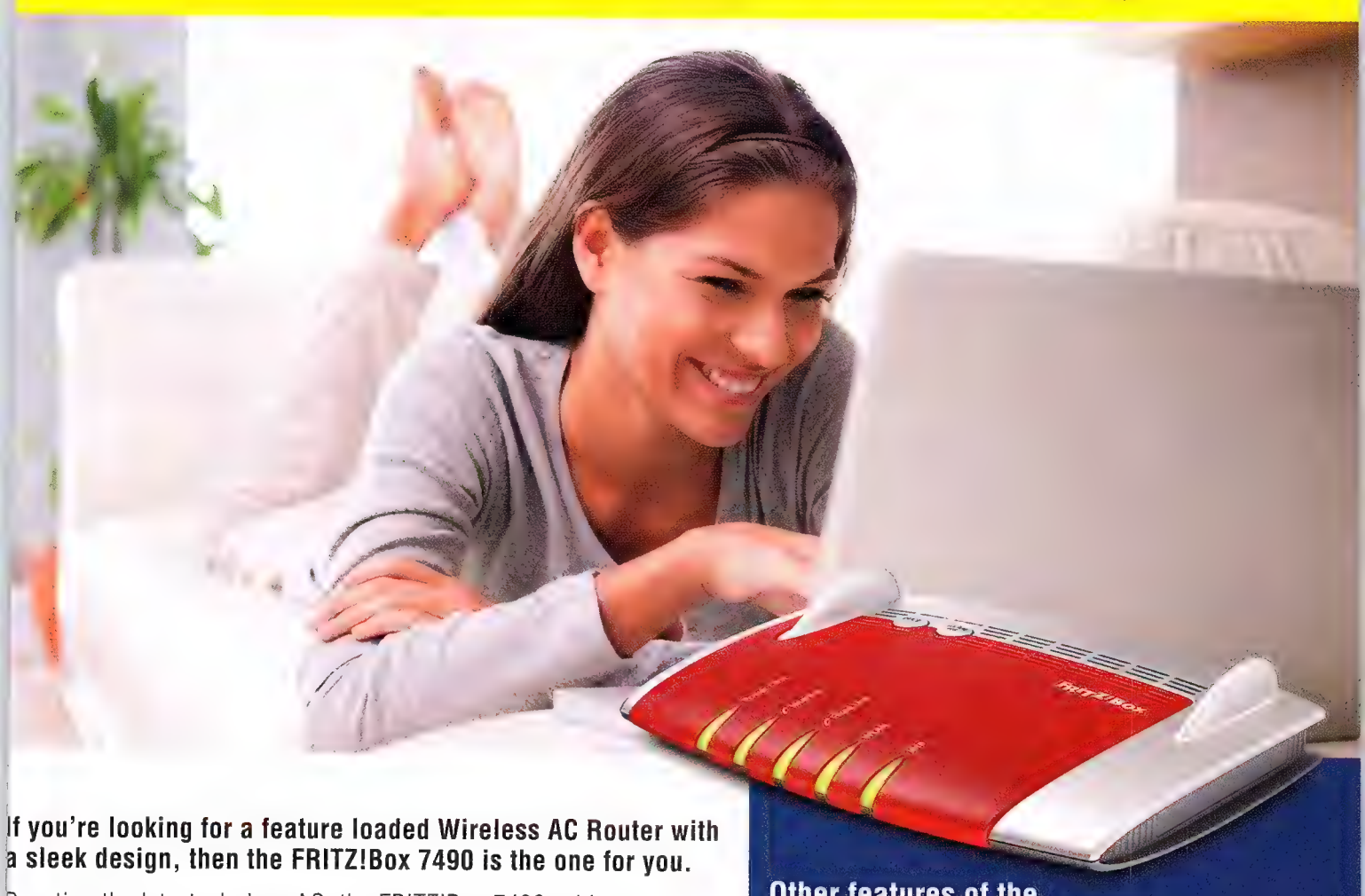

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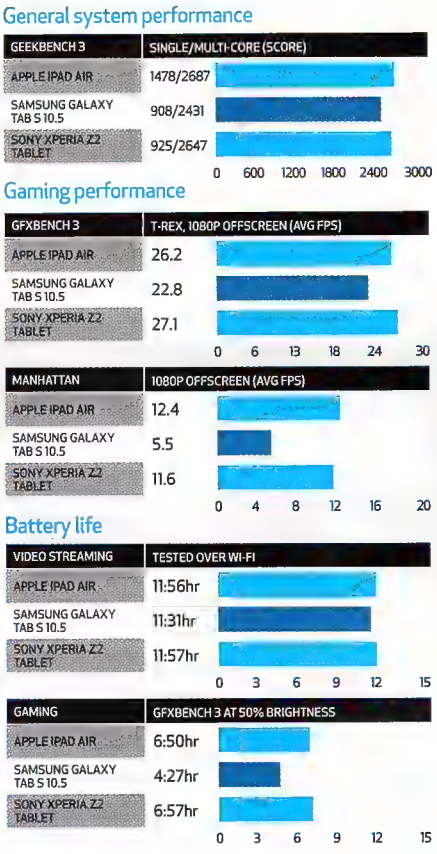


Samsung Galaxy Tab S 10.5

Does Samsung finally have what it takes to beat the iPad?

Looking very much like a blown-up Galaxy S5s, the new Tab S tablets – which come in 8.4- and 10.5-inch sizes (we tested the latter) – are the units that Samsung's decided are finally good enough to wear the flagship 'S' family name. These are the new weapons against the iPad Air and iPad mini with Retina which are still ruling the roost when it comes to premium tablets. There's not a lot of competition from Android at this top-end of the tablet market – it's basically only Sony's 10.1-inch Xperia Z2 Tablet that Samsung needs to worry about.

Performance wise, the Tab S 10.5 has basically the same internals as the Galaxy Note Pro 12.2 (tested in our June roundup, pg 48). The Exynos 5 Octa that runs the show is made up of two chips – a more powerful quad-core 1.9GHz Cortex-A15 that's brought out for tougher tasks, and a slower quad-core 1.3GHz Cortex-A7 that's used for light work. That should give better battery life, although in our two tests (streaming video and gaming) the Tab S's 7,900mAh battery returned rather average results – and that screen and CPU really chew power when gaming.

The Mali T628 MP6 graphics processor inside is likewise just adequate. It's about on par with what's in the iPad Air, though Sony's Z2 tablet actually packs a faster GPU – the Adreno 330 – which can, in some benchmarks, manage twice the framerate. (Samsung, oddly, has used the Adreno 330 in the Galaxy S5 phone – the competition in handsets is fierce enough to warrant the upgrade.)

What really sets the Tab S above the competition is its AMOLED display – it's a stunningly bright and vivid screen that's pin-sharp at 2,560 x 1,600 pixels. Movies and games look, amazing – this is unarguably the best tablet display we've seen. Throw some Ultra HD content on there and you'll be blown away. We've only got one complaint about the screen: it's a little too bright for our tastes. That's easy to rectify, and you don't have to sacrifice auto-brightness either – as on Samsung's S5 phone, you can adjust the level to be a little dimmer or brighter than the default.

The Tab S has also adopted the fingerprint scanner of the S5, which lets you swipe over the Home button to unlock the unit – although on our model it was a little unwieldy. This bigger of the two Tab S's is intended to be used in landscape mode, with buttons located on a long edge, and gripping the tablet with one hand while swiping downward with the other isn't particularly easy.

The Tab S is not weatherproof either – another area where the Z2 Tablet is superior, with an IP58 rating for water and dust resistance.

So how does all that stack up? Samsung has, overall, done enough here to pip the competition, but it's a little disappointing that the performance, particularly for gaming, doesn't match Sony' Z2 Tablet (or Samsung's own S5 phone). Samsung's clearly hoping that the stunning display will be enough to carry the show – and, as the best tablet screen we've seen, it does accomplish this. Apple's range of tablet apps is still ahead of Android by a large margin, and if you want the most future-proof and physically robust Android tablet you can buy, Sony's Z2 Tablet is still the best. But when it comes to actual use, Samsung's AMOLED screen does trump the competition – both Android and iOS.

Dan Gardiner

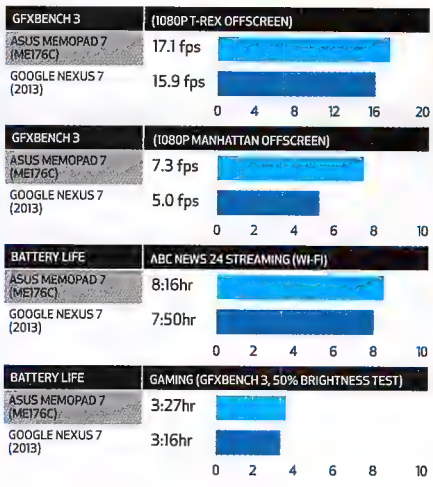
Verdict

Features	★★★★
Performance	★★★½
Value	★★★★½

The superb AMOLED display makes it the premier tablet for Android lovers. Pity it's not a little more future-proof.

★★★★

"The MeMO Pad's main weapon against the Nexus is a theoretically cheaper price."



TABLET

$229 | WWW.ASUS.COM/AU

ASUS MeMO Pad 7 (ME176C)

ASUS takes another shot at the budget tablet space.

ASUS's 7-inch MeMO Pad plays at the other end of the market to the Galaxy Tab S 10.5 – and in this budget space, the competition is a lot fiercer. At this 7-inch size, the tablet to beat is still Google's Nexus 7, which was released back in mid-2013 and is predicted to get an update very shortly. Given that ASUS actually makes the Nexus 7 hardware it's a little surprising that, in some regards, the MeMO Pad 7 is arguably a bit of a step backwards – although that's not to say this isn't a reasonably attractive package for the price.

With Android 4.4 running on a quad-core Intel Atom Z3745 processor (one of Intel's current 22nm Bay Trail units) with 1GB of RAM and 16GB of onboard storage, it's certainly got the basics in order, and there's also a microSD slot with support for cards up to 32GB if you want to expand the storage a tad. While it's physically thicker than a Nexus 7, it is at least around the same weight at 295g, and a similar soft-touch plastic back makes it pleasant (and secure) to hold in the hand. It pips Nexus 7 for performance too, with slightly better gaming, battery life and general system benchmark results.

With the MeMO Pad, ASUS also has chosen to make its Android UI a feature rather than an afterthought. The Taiwanese company's always been a soft touch when it comes to customising Android's front end, and that approach thankfully continues with its (now branded) 'ZenUI', which provides a series of tweaks across the OS that don't interfere with the speed and slickness of the base OS. (In fact, about the only thing we didn't like was the unnecessarily-glaring key press sounds – made to simulate the sound of an old-fashioned typewriter, clack-clack-clacking its way to annoy everyone around you. Admittedly, Samsung's done the same with its Tab S – and in both cases you can thankfully turn this off.)

What you don't get at this price are all of the frills – there's no auto brightness for example and the display is only 1,280 x 800 pixels, rather than the 1,920 x 1,200 or greater resolution that's common on more-expensive 7-inch models. Still, that screen is still a good one – an IPS display with nice natural colours, even backlighting and a sharper picture than the 1,024 x 768-pixel 8-inch display on Acer's A1-830 offering ($250).

The MeMO Pad's main weapon against the Nexus is a theoretically cheaper price. The 16GB MeMO Pad goes for $229 from major retailers, vs the RRP of $299 for the same-capacity Nexus 7, although the reality is that you can grab a Nexus 7 for $250 or less, with Kogan selling the 16GB model for $239, for example.

The Nexus 7 isn't the only competition either. Amazon's 7-inch Kindle Fire HD is only $219 for the 8GB model, and packs a similar 1,280 x 800-pixel display, although the internals are now a little dated.

For an extra $30, you can also find Samsung's 8-inch Galaxy Tab 4. It's a slightly slicker overall design and, for us, that jump to an 8-inchscreen provides a more appealing overall package for media, web and gaming use. At 320g, it only adds a little bit of carry weight to the ASUS's 295g.

In all then, ASUS has built a reasonably inviting little budget tablet with the MeMO Pad 7, but it's not quite compelling enough to become the leader of the pack. ■ **Dan Gardiner**

Verdict

Features	★★★½
Performance	★★★★
Value	★★★½

A well-balanced tablet for the price, but doesn't quite beat the competition.

★★★½

CPU rendering performance

CINEBENCH R15	INDEX SCORE: HIGHER IS BETTER
ASUS ROG GENE	788
ASUS Z97-A	752
ASROCK EXTREME4	778

0 200 400 600 800 1000

4K random read/write performance

AS SSD	MB/S : HIGHER IS BETTER
ASUS ROG GENE	95
ASUS Z97-A	90
ASROCK EXTREME4	88

0 20 40 60 80 100

1080p gaming performance

TOTAL WAR: ROME II	(MIN) FRAMES PER SECOND: HIGHER IS BETTER
ASUS ROG GENE	96
ASUS Z97-A	95
ASROCK EXTREME4	97

0 20 40 60 80 100

MOTHERBOARD

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ASUS RoG Maximus VII Gene

Not the smallest, not the cheapest, but one of the best Z97 boards so far.

Recently ASUS was awarded an *APC* recommends award in our 9-Series motherboard roundup (*APC* September, page 63) – not with its Republic of Gamers (RoG) Z97, but with its more value-oriented Z97-A. The RoG team is back though, hoping to get us more excited about the Maximus VII Gene. And you know what? We are.

The 'Gene' name denotes the halfway house micro ATX form factor. It's a far smaller board than the full ATX spec, but not as tiny as the mini-ITX. That might have you wondering what the point is given that all the power you need can be provided by a decent mini-ITX mobo, but the few things you sacrifice by going for a very small board can be returned to you with a micro ATX option such as this RoG Gene.

It means you have the option for multiple graphics cards thanks to a second x16 PCIe 3.0 slot. Of course you're not going to get three or four-way graphics arrays, but the diminishing returns offered by anything after a second GPU make that essentially irrelevant anyway. In terms of expansions, the extra space you get from micro ATX boards means you also get a x4 PCIe slot, should you be among the dwindling number of gamers with dedicated sound cards.

ASUS is trying to tread the line on that front, and has included a separate sound 'blade' – the SupremeFX II Impact. Screwing the PCB into the motherboard means you avoid the need for alternative insulation to avoid audible interference from the rest of the board's electronics. The extra scale of the micro ATX form factor also means you get another two DIMM slots should you need to really fill out your machine with up to 32GB of DDR3 RAM.

In accordance with Intel's Z97 differentiation, the Gene includes the M.2 storage interface and can house full 80mm slices of SSD goodness. The only slight snag with the solitary M.2 slot is that it's situated in between the two PCIe slots, so even if you've only one GPU installed it's still going to be sat right on top of the M.2 drive. There's also the fact that SSDs have been known to generate heat. Strap a stock R9 290X into this board and you'll have a 93°C hunk of super-heated silicon radiating away above your main system drive.

TINY TITAN

So, everything you might miss from a mini-ITX board is here in the RoG Gene, and in a rather svelte form factor too. You get class-leading performance as well. Across the benchmarking suite the Gene either tops the list or as near as makes no odds. CPU and storage performance are stellar, as is the gaming prowess. It sits at the top of the charts in the overclocking stakes, too.

In short, the Gene is pretty much all the Z97 motherboard you need. The only issue is that, inevitably, you pay a premium for that functionality and performance. Of all the 9-Series boards we've tested so far, only the RoG Hero costs more. If you're on a very tight budget, the RoG brand isn't really for you, but if you're looking for the very finest of components and the pinnacle of performance, the Gene is a great choice – and not just as a small form factor motherboard.

Dave James

Verdict

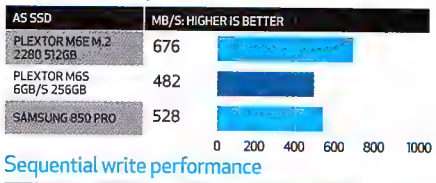
Features	★★★★½
Performance	★★★★★
Value	★★★★

A fantastic motherboard, regardless of form factor, with class-leading performance and top functionality.

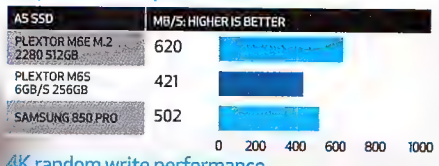
★★★★½

"Plextor backs its new M6e drive with a five-year warranty, which is two more years than it gives its SATA-based M6S."

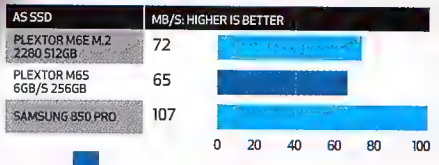
Sequential read performance



Sequential write performance



4K random write performance



apc RECOMMENDS

SSD

$525 | WWW.PLEXTOR.COM

Plextor M6e M.2 512GB

A thin format SSD that breaks the 6Gbps barrier with ease.

SSD performance has leapt forwards in a short space of time. Now, even drives at the value end of the spectrum are close to flooding the SATA 6Gbps interface. Therefore, something else is needed to prevent future drives from becoming bottlenecked. That 'something' is the PCI Express lanes of the motherboard. In theory, these lanes could give drives immense amounts of bandwidth to play with.

For a while, the future of the PCIe-based SSD seemed to lie with the SATA-Express hybrid specification, but that theory appears to have had sand kicked in its face by the new M.2 interface-shaped kid on the block. And not just in ultrabooks or thin-and-light notebooks either; Intel's 9-Series mobos have brought M.2 to the desktop crowd. If the new Z97 boards are anything to go by, M.2 could quickly become the standard for all PCIe-based storage.

The Plextor M6e is built on the full-length 2280 (80 x 22mm) M.2 format and comes in 128, 256 and 512GB capacities. This month, we've been testing the flagship 512GB drive. The M6e is an x2 PCIe device, which means it uses just two lanes of the PCIe bus, and even though it's bottlenecked at 1GB/s, that's still some leap over the SATA 6Gbps interface. We recently reviewed Plextor's 2.5-inch M6S SATA SDD, so it will be interesting to compare the performance of the two storage interfaces.

SIMPLE DESIGN

The 512GB capacity is made up of eight Toshiba 19nm MLC NAND packages that sit four-per-side on the PCB, plus a Marvell 88SS9183 controller and 1GB of DDR3 cache.

When we tested the drive with the ATTO benchmark it gave out scores of 733MB/s for reads and 686MB/s for writes, so a little shy of the official read figures but nicely surpassing the quoted write scores. The incompressible scores in our AS SSD tests were less stellar, but both still clear of any competition. The scores eclipse the 6Gbps M6S we tested, which managed read/write scores of 516MB/s and 444MB/s respectively at best. To be honest, this M6e blitzes every other SATA-based drive we've tested, even the top-end (but SATA-limited) Samsung 850 Pro.

When it came to handling the small files of everyday use, things weren't quite so exciting. However, it wasn't the SATA interface that held our SSDs back in those tests, so it's not much of a surprise to see the M6e showing only a very small improvement over the standard 6Gbps drive – this can be seen from the 4K AS SSD benchmark. The latest drives from Samsung, SanDisk and Crucial have all posted better 4K scores. Nonetheless, Plextor backs its new M6e drive with a five-year warranty, which is two more years than it gives its SATA-based M6S.

So while this is the first M.2 drive that surpasses the 600MB/s barrier, it's still based on the old AHCI standard for hard drives. It looks like we might have to wait for the NVMe-based PCIe drives to really start taking advantage of the 1GB/s bandwidth offered by the x2 PCIe interface.

Simon Crisp

Verdict

Features ★★★½☆
Performance ★★★★½
Value ★★★½☆

With excellent benchmarks, it's a bright start for M.2 drives, but this little drive is unlikely to be out in front for long.

★★★★☆

"Samsung has beaten its rivals to market. This is one of the benefits of being able to produce the drive in-house."

Sequential read performance

AS SSD	MB/S: HIGHER IS BETTER
SAMSUNG 850 PRO	528
SAMSUNG 840 PRO	520
CRUCIAL M550	504

0 200 400 600 800 1000

Sequential write performance

AS SSD	MB/S: HIGHER IS BETTER
SAMSUNG 850 PRO	502
SAMSUNG 840 PRO	491
CRUCIAL M550	463

0 200 400 600 800 1000

4K random read performance

AS SSD	MB/S: HIGHER IS BETTER
SAMSUNG 850 PRO	37
SAMSUNG 840 PRO	28
CRUCIAL M550	22

0 10 20 30 40 50

SSD

$449 | WWW.SAMSUNG.COM/AU

Samsung 850 Pro 512GB

Samsung tightens its grip on the solid-state market with a brilliant SSD.

The 850 Pro is Samsung's new flagship consumer SSD, and the follow-up to the 840 Pro. That drive was one of the best performing SSDs around when it launched in September 2012, and Samsung is hoping to continue the tradition.

The 850 Pro is still based on 2-bit MLC NAND flash memory, but with a few enhancements. The MEX controller has had a boost from 300MHz to 400MHz, but the headline new feature is 3D V-NAND flash memory. This is Samsung's proprietary 3D tech, in which the memory chips are layered vertically as well as horizontally. It's likely that the entire industry will eventually adopt a similar version of 3D flash memory, but Samsung has beaten its rivals to market. This is one of the benefits of being able to produce the drive in-house.

The 850 Pro represents the second generation of 3D V-NAND. It debuted in enterprise SSDs with 24 cells layered on top of each other. This time, Samsung has managed to layer 32 flash cells.

It says the 850 Pro can deliver 550MB/s sequential read speeds and 520MB/s sequential write speeds. Its documentation also claims 100,000 IOPS during random 4K reads and 90,000 IOPS during writes. With the 128GB version of the 850 Pro, the sequential write speed drops to 470MB/s, which is expected from smaller capacity SSDs; although it's an improvement on the 128GB 840 Pro model, which only managed 390MB/s.

The fact that we're almost hitting the SATA performance limits with the lowest capacity options in this range highlights what the new V-NAND can offer across the board.

Our tests support Samsung's claimed scores, with identical numbers for this 512GB version in terms of sequential read and write speeds.

The 4K random results are a little less precise, offering lower write speeds than promised and slightly higher random reads.

ENDURANCE

It might seem odd that with the release of the latest 9-Series motherboards Samsung hasn't dropped the M.2 bomb with its 850 Pro drive, but the SATA interface is still the biggest draw in consumer SSD terms. And while the SATA interface is almost saturated by even low-capacity SSDs, endurance is an important consideration. That's been the focus of the latest Crucial and Intel SSDs, and Samsung isn't to be left behind in those stakes either.

By slackening the production process on its memory to a more sedate 40nm, it can be faster and more durable than the 19nm memory we've seen in its other drives. The drive is rated for 150TB of writes, which translates to roughly 40GB/day for 10 years. This is double the endurance of the 840 Pro, and Samsung backs it up with a hefty 10-year warranty.

In the two years since Samsung launched the 840 Pro, other SSDs have caught up with its sequential read and write speeds. To stay on top, the 850 Pro had to offer more. Its high write endurance and better power consumption are just that, leapfrogging what most consumer SSDs can hope to give. ■ **Orestis Bastounis**

Verdict

Features	★★★★★
Performance	★★★★★
Value	★★★½

Despite the relatively high price, the 850 Pro shows Samsung is still sitting at the top of the SSD game. A great drive.

★★★★½

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apc RECOMMENDS

MONITOR

$920 | WWW.VIEWSONIC.COM.AU

ViewSonic VP2772

One for the professionals among us.

Viewsonic is targeting the pro crowd with its latest 1440p monitor, the VP2772. At a little over $900, there are more affordable consumer panels with similar features out there. But ViewSonic is pitching the VP2772 specifically at photographers, graphic designers, video editors and other design and multimedia professionals.

That's because this monitor features a 12-bit colour engine and 14-bit LUT (Look Up Table) that allows it to process, grade and render 1.07 billion colours and grey scales, while covering 99% of the Adobe RGB colour space.

Like its predecessor, the VP2770-LED, the model sports a 27-inch frame. But this monitor's appearance can best be described as workmanlike, if not just a bit dull. It comes with an adjustable stand that can be raised upwards to 5.9 inches and can pivot 90 degrees into portrait mode.

> "ViewSonic is pitching it specifically at photographers, graphic designers, video editors and other design professionals."

At the back of the display are a number of ports including: Dual-Link DVI, HDMI v1.4 and mini-DisplayPort, in addition to four USB 3.0 ports (two on the side and two on the rear). It also features DisplayPort v1.2 for daisy-chaining a second monitor.

Using the menu controls, you can tweak a number of display settings, including contrast, brightness, sRGB and Adobe RGB presets, response times, gamma, Dynamic Contrast and overscan. You can also choose between a number of colour tone presets, and a power-friendly Eco Mode.

Set to its Native colour temperature, the VP2772 offered excellent picture quality out of the box. Brightness is evenly distributed, with no overly bright or dark spots. Nor could we detect any backlight bleed along the edges. The monitor produces deep blacks and reds, while greens, blues and yellows appear vibrant without having to boost contrast or brightness. Once set up, everything on the screen is clearly viewable from a 178-degree angle.

The ViewSonic VP2772 is a well-constructed professional monitor that offers superb picture quality, though some tinkering is required to correct the distorted image that's produced on OS X, particularly reducing the sharpness to halfway. ■ **Kane Fulton**

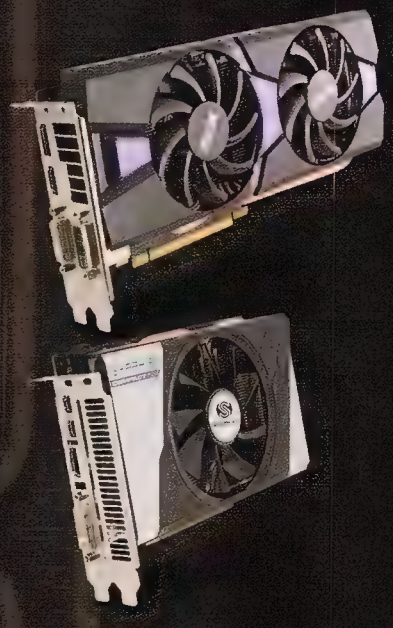
Verdict

Features	★★★★½
Performance	★★★★½
Value	★★★½

27 gorgeous inches of Adobe Colour QHD resolution on a 178 degree IPS display.

★★★★½

The competition is green with envy.



Dual-X R9 285 OC

- Dual-X award winning technology
- Factory overclocked
- Quiet and efficient cooling
- Engine clock: 965 MHz
- Memory clock: 5,600Mbps effective

ITX Compact R9 285 OC

- Specially developed for small form factor PC systems
- Only 171mm long
- Factory overclocked
- Engine clock: 928MHz
- Memory clocks: 5,500 Mbps effective

The SAPPHIRE R9 285 graphics card is faster than the Competition. That's because we designed it for a single purpose: to play demanding PC games at maximum detail better than any card in its class. The SAPPHIRE R9 285 Graphics Card is loaded with the latest from Graphics Core Next Architecture, including mixed screen resolution and orientation for AMD Eyefinity Technology and support for DirectX®12 and AMD's groundbreaking Mantle API. So get Radeon™ and get gaming with forward-looking technology for the serious PC gamer.

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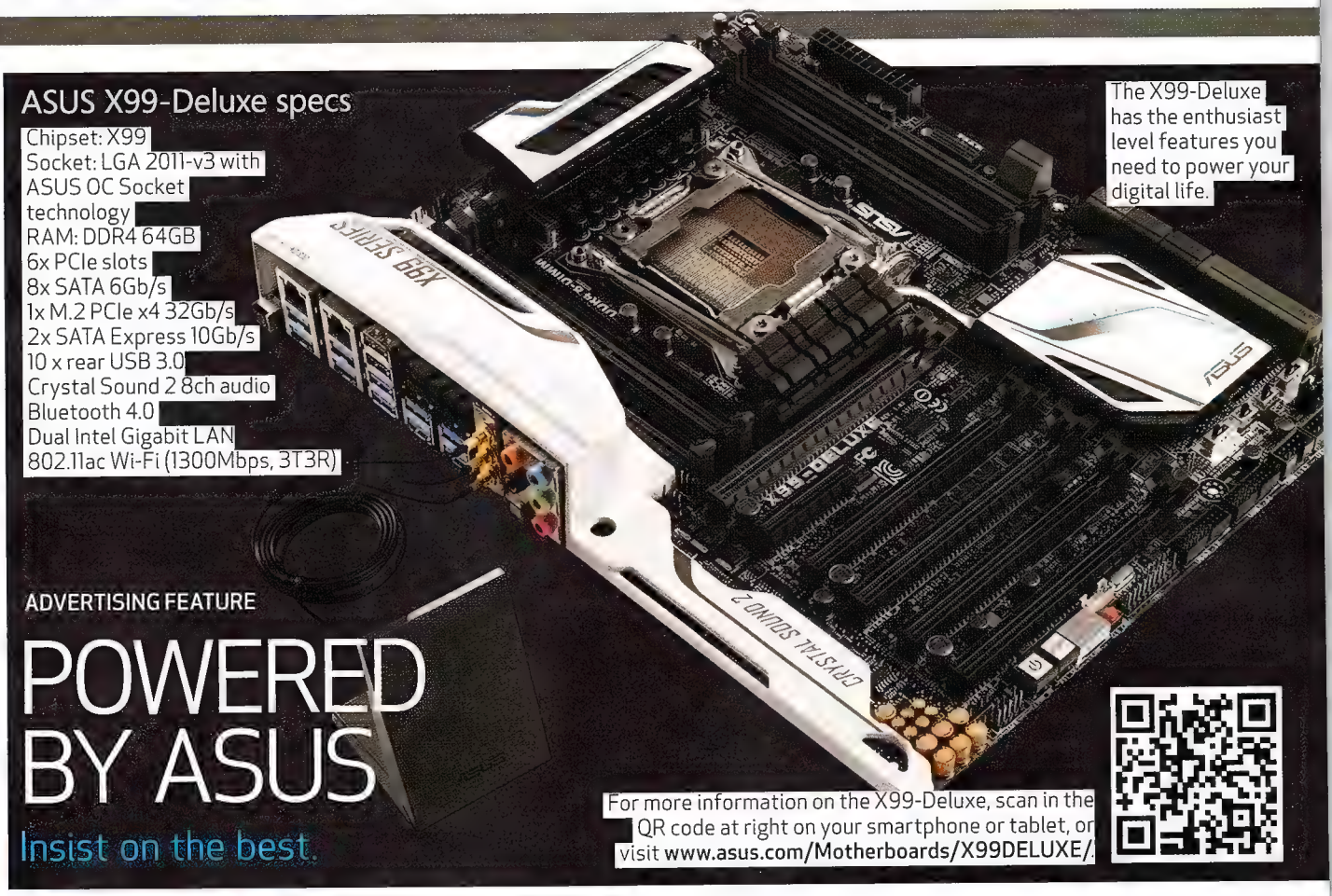
ASUS


ASUS X99-Deluxe specs
Chipset: X99
Socket: LGA 2011-v3 with ASUS OC Socket technology
RAM: DDR4 64GB
6x PCIe slots
8x SATA 6Gb/s
1x M.2 PCIe x4 32Gb/s
2x SATA Express 10Gb/s
10 x rear USB 3.0
Crystal Sound 2 8ch audio
Bluetooth 4.0
Dual Intel Gigabit LAN
802.11ac Wi-Fi (1300Mbps, 3T3R)
The X99-Deluxe has the enthusiast level features you need to power your digital life.
ADVERTISING FEATURE
POWERED BY ASUS
Insist on the best.
For more information on the X99-Deluxe, scan in the QR code at right on your smartphone or tablet, or visit www.asus.com/Motherboards/X99DELUXE/.

With a long history of innovation, it's little wonder ASUS is the leading motherboard manufacturer. From gaming machines to professional workhorses, an ASUS system is a high performance solution tailored to your needs. ASUS also focuses on the environment, with a full range of green computing features. Explore why your next PC should be powered by ASUS.

ASUS X99-Deluxe

FLAGSHIP PERFORMANCE

This high-performance motherboard supports the latest Intel Core i7 8-core CPUs as well as the fastest-available DDR4 RAM at 3200MHz+. It's packed with a range of cutting edge features to enhance your digital lifestyle while giving the best gaming, work and media experiences possible on PC.

ASUS POWERED WORKFLOW

The X99-Deluxe supports up to 64GB of DDR4 RAM as well as SATA Express, capable of HDD speeds up to 10Gbit/s.

For the ultimate in processing power, the X99-Deluxe uses the new Intel Core i7 CPUs with patented ASUS OC Socket to create a high performance platform with up to 8 cores. From video editing to hardcore number crunching, the ASUS X99-Deluxe has the grunt you need.

ASUS POWERED GAMING

The X99-Deluxe is built to unleash the potential of multiple GPUs in a variety of configurations and a maximum of five (5) PCI Express 3.0 devices at x8 link speed. Turbo APP is a one stop solution that allows you to get the very best performance from your games. You can overclock your CPU, prioritise network traffic to avoid lag, optimise your audio and adjust your fans to keep your system running cool yet quiet.

ASUS POWERED DIGITAL LIFESTYLE

It's not just about performance – your ASUS motherboard is jam packed with features to improve your digital life. With Wi-Fi GO!, you can easily setup and manage access to cloud storage, handle file transfers and easily push media streaming to smart devices. You can also link your smartphone or tablet to your PC as an external monitor or remote keyboard and mouse.

ASUS POWERED MEDIA PLAYBACK

Your ASUS X99-Deluxe features the latest Crystal Sound 2 for an immersive audio experience. You also get powerful audio pre-sets to switch between gaming, music and movie modes.

ASUS POWERED CONTROL

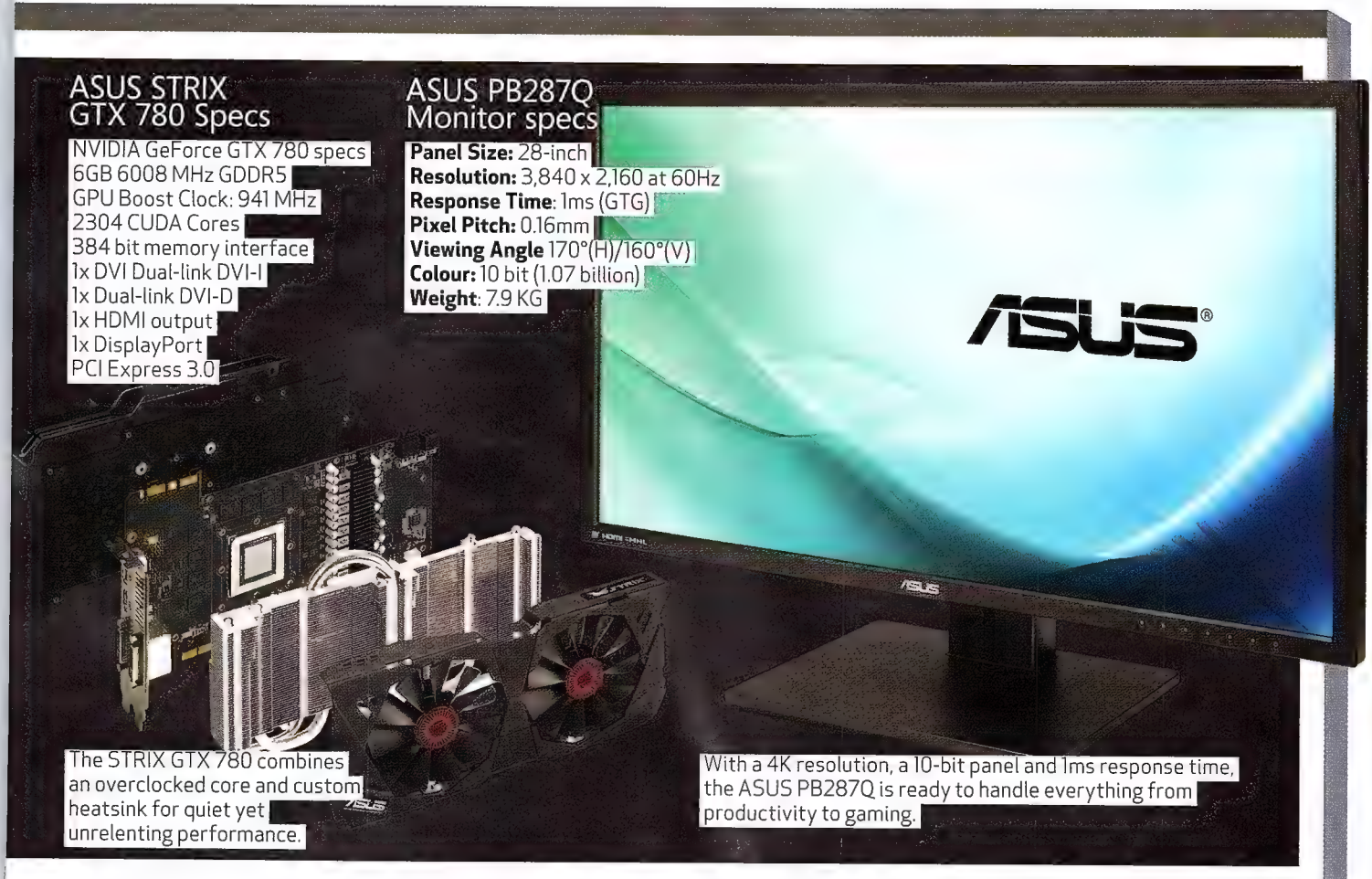
The ASUS OC socket allows you to monitor more voltages, increase CPU frequency and push your CPU voltage to the limit. You can also use Xtreme DDR4 O.C. to increase your RAM frequency up to 3200+MHz. A powerful new UEFI interface lets you monitor your system, adjust cooling or use the EZ Tuning Wizard to easily get the most from your system. You can even remotely monitor your system in real time on your smartphone thanks to Push Notices. Be in control of your digital life!

ASUS STRIX GTX 780

STRIX means a no compromise gaming experience with the latest hardware. Ready to deliver 4K content and perfect for a multi-GPU gaming machine, the STRIX GTX 780 will maximise your entertainment.

GLIDE PAST THE COMPETITION

The STRIX GTX 780 ships, already pushing the boundaries, with 2,304 overclocked CUDA cores boosting up to 941MHz. The massive 6GB of RAM uses a


ASUS STRIX GTX 780 Specs
NVIDIA GeForce GTX 780 specs
6GB 6008 MHz GDDR5
GPU Boost Clock: 941 MHz
2304 CUDA Cores
384 bit memory interface
1x DVI Dual-link DVI-I
1x Dual-link DVI-D
1x HDMI output
1x DisplayPort
PCI Express 3.0
ASUS PB287Q Monitor specs
Panel Size: 28-inch
Resolution: 3,840 x 2,160 at 60Hz
Response Time: 1ms (GTG)
Pixel Pitch: 0.16mm
Viewing Angle 170°(H)/160°(V)
Colour: 10 bit (1.07 billion)
Weight: 7.9 KG
ASUS
The STRIX GTX 780 combines an overclocked core and custom heatsink for quiet yet unrelenting performance.
With a 4K resolution, a 10-bit panel and 1ms response time, the ASUS PB287Q is ready to handle everything from productivity to gaming.

wide 384-bit interface and a 6,008 MHz GDDR5 clock speed to keep your pixels flowing at ultra-high resolutions. Compared to the reference design, the STRIX is 15% faster playing *BattleField 4* – even at 3,840 x 2,160 with the detail level cranked to high! When playing the graphically intense game *Metro Last Light*, the STRIX GTX 780 pulls ahead compared to the reference design, with an extra 7.9% performance. No matter what your game of choice is, the STRIX GTX 780 gives you the edge.

THE TACTICAL ADVANTAGE OF SILENCE

Combining quiet yet efficient cooling, The STRIX GTX 780 uses the latest ASUS DirectCU II cooler that totally outperforms the reference design. The DirectCU II uses exclusive 10mm heatpipes which transport 40% more heat away from the GPU Core. From there it's dissipated by a 220% oversized array of fins which mean that under load the STRIX GTX 780 runs 38% cooler than the reference GTX 780. There is no downside either – the custom design is supported by extra-large fans which mean despite all the extra cooling capacity, the STRIX GTX 780 remains 3x quieter than the reference design. Even better, for less graphically intense titles such as *Starcraft 2* and *League of Legends*, the STRIX GTX 780 runs absolutely silently.

In fact any time the GPU temperature is under 65°C the fans stop, letting you focus 100% on the task at hand.

TECHNOLOGICAL SUPERIORITY

To ensure rock solid gaming, the STRIX GTX 780 uses 10 Phase Super Alloy Power as well as the DIGI+ VRM digital voltage regulator. This minimises power noise by 30% and improves power efficiency by 15%. It also increases the stability (especially important when overclocking) and combined with hardened components, gives a 2.5x increase in longevity over the reference design. While performance is already phenomenal out of the box, using the included GPU Tweak you can even push the STRIX GTX 780 further. The powerful software lets you perform real-time overclocking as well as monitor temperatures, power use and precisely control cooling. You can also use GPU Tweak to easily stream your gaming sessions over the internet.

ASUS PB287Q

AN EXPERIENCE ONLY 4K CAN DELIVER

With an ultra-high definition 3,840 x 2,160 resolution and 157 pixels per inch, the 28-inch PB287Q shows off every little detail. The 16:9 10-bit WLED panel can display 1.07 billion colours – ensuring rich yet accurate images for an immersive experience. The PB287Q is no slouch when it comes to gaming either, with an impressive 1ms response time and 60Hz refresh rate to keep things totally smooth. It's also got a 330cd/m² brightness and a 100,000,000:1 ASUS Smart Contrast Ratio to keep blacks as dark as possible.

THE FULL PACKAGE

The PB287Q is not just a pretty face, with a range of features that make it an ideal monitor for work or play. Connectivity is extensive, with two HDMI ports, DisplayPort, 3.5mm Audio input and output as well as the ability to connect a portable device via MHL. You can display two sources at once, side by side or picture in picture. ASUS has also included SplendidPlus video intelligence technology that automatically optimises videos and images in addition to providing a range of viewing modes for every situation. It's easy to get the perfect viewing position thanks to the ergonomically designed stand that includes tilt, swivel, pivot and height adjustments.

software

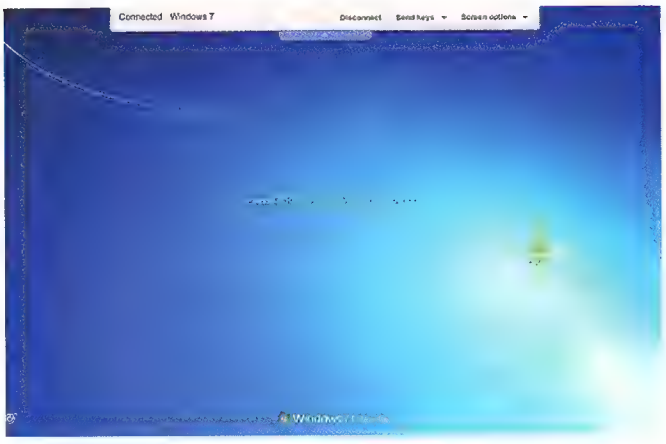
» APPS FOR ALL THE PLATFORMS EDITED BY PETER DOCKRILL

Windows » SOFTWARE

Chrome Remote Desktop

Google's Remote Desktop software is simple to use and completely free.

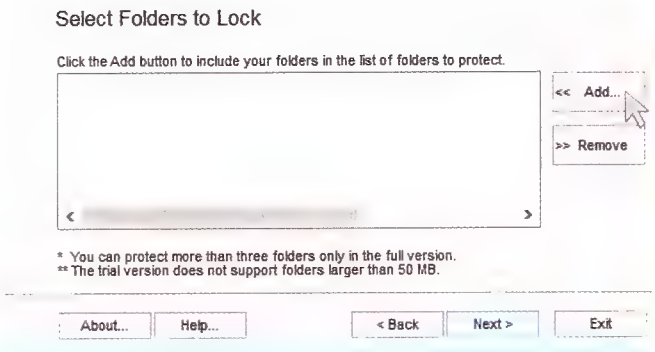
FREE | GOOGLE | TINYURL.COM/9UPEAM7



The ability to remotely access your computer from a smartphone or tablet is the Holy Grail of on-the-go computing, as it gives you the power to perform any kind of heavy PC lifting that your mobile device can't easily do on its lonesome. But until now most remote control and access apps have either been relatively complicated to set up or required spending cash on the necessary software.

Luckily, Google's Chrome Remote Desktop feature has made it all a lot easier, and — best of all — it's completely free. Fire up Chrome and enter `chrome://apps/` in the address bar. Click the 'Web Store' icon to the lower right, search for remote desktop and click the '+' icon on the first result. Follow the steps to install it and set up a PIN if necessary. Next, install the Google Remote Desktop app on your Android or iOS device, fire it up and log in. You should now have access to your desktop and programs. It even works if you're on a mobile network connection, although of course you'll still need to ensure your PC is already turned on back at home.

Obviously, due to control limitations some apps will work better than others when accessing them from your mobile device — we wouldn't recommend any intensive Photoshop editing sessions conducted from your bus seat, for example — but for those times when you need access to a remote file or program, Chrome Remote Desktop is indispensable.


Select Folders to Lock
Click the Add button to include your folders in the list of folders to protect.
<< Add...
>> Remove
* You can protect more than three folders only in the full version.
** The trial version does not support folders larger than 50 MB.
About...
Help...
< Back
Next >
Exit

Folder Password Expert

US$39.95 | ZQS SOFTWARE TEAM | WWW.FOLDER-PASSWORD-EXPERT.COM

A nifty program that allows you to protect folders against unwanted access. It can lock folders on an internal hard drive, flash drive, external USB drive or network drive. When folders are password-protected and locked, their contents cannot be read, copied, modified or deleted. Folder Password Expert guarantees your privacy by making it impossible for anyone to access your data — even in Windows Safe Mode. If somebody logs on under your Windows account, they still won't be able to access your data without that crucial password, which for added security is not stored anywhere in Windows. The full program isn't cheap, but give the free 30-day trial a go to see if it's worth adding to your collection.

Muffin Knight

$1.49 | ANGRY MOB GAMES | TINYURL.COM/KNSQ4EN

One of our favourite arena platformers from mobile land has just dropped on Windows 8.1, and at only $1.49 it definitely warrants your attention. *Muffin Knight* charges you with collecting as many, um, muffins as you can — a truly arbitrary MacGuffin if ever there were one — while avoiding the endless onslaught of on-screen baddies. The kicker is: every time you grab your heart's desire you transform into another character — with a different weapon or ability — resulting in some relentlessly chaotic and unpredictable (but oh so addictive) gameplay. Frenetic arcade action that'll have you hopping mad until you reach the end. Lots of fun, and much more approachable than its clear inspiration, *Super Crate Box*.

Roxio Toast Titanium 12

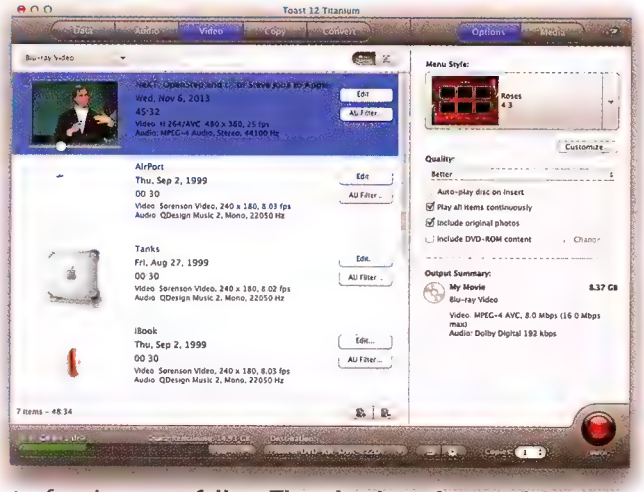
The king of optical media tools for the Mac is still going strong.

$99.99 | ROXIO | WWW.ROXIO.COM.AU

For what seems like forever, Roxio's Toast has been the de facto recommendation for authoring DVDs and CDs on a Mac. Naturally, it's a tougher sell for Roxio these days, when a CD/DVD drive is optional for Macs. However, we do live in a world where optical media is still used so Toast is still relevant.

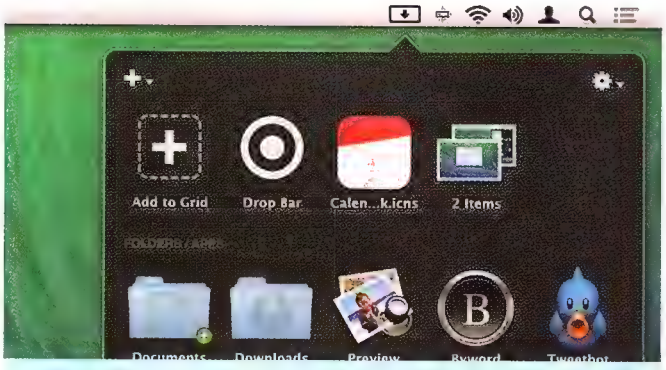
The latest version is Toast Titanium 12, which adds screen-capture tools and the ability to burn HD content on normal DVDs for playback in Blu-ray devices. It'll also burn to blank Blu-ray discs if you have the correct external drive. There's a Pro version of Toast 12, which adds a selection of other software tools for creating HDR images and cleaning up audio on speech recordings and the like.

Toast remains a simple app to use, and though there are plenty of features and scenarios for burning your data, the



interface is easy to follow. The tabs along the top of the main window keep things obvious and the most popular tasks are just a click away.

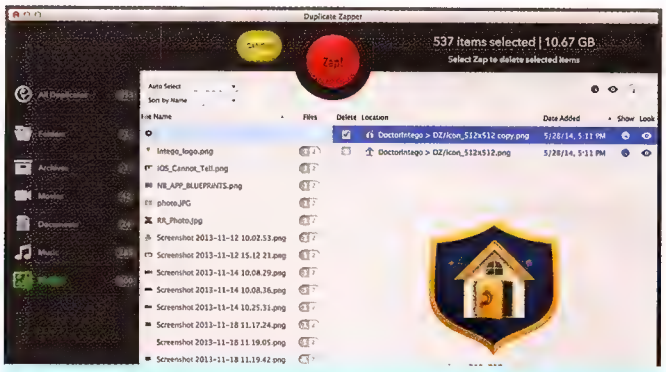
If you just want to burn the odd disc, the cost of Titanium 12 could be too high and the software too multifaceted for your needs. But if blank DVDs are still piling high in your home or office and you burn data regularly, the extras are worth the investment – we're not sure, however, the same can be said of the Pro version. Though time is running short for Toast and its ilk, Titanium 12 is a fine product that continues to maintain a good reputation.



Dropzone 3.2

US$10 | APTONIC | APTONIC.COM

Click Dropzone's menu bar icon to access its grid. It's split into sections: Drop Bar; folders and apps; actions; and progress. Folders and apps can be used to stash app shortcuts, along with folder move/copy actions. Below, advanced actions can be added from a built-in selection or via the web. These include FTP uploads, app install automation, and sharing over AirDrop. In all cases, just drag an item from Finder or another app to one of the Dropzone icons and the action starts. The split grid is new to Dropzone 3 and improves usability, as does the simpler way to add actions, via a drop-down menu. The Drop Bar is the real star, pausing drag actions, and making it simple to collect groups of items (like those from full-screen apps or shortcuts from web browsers) to then drag elsewhere.



Duplicate Zapper

$8.99 | INTEGO | INTEGO.COM

From the off, Duplicate Zapper brings a little joy to the dry subject of duplicate scanning and deletion, largely through an intuitive interface. You select which file types you'd like to scan for (folders, archives, music and the like), and where you want to scan. The resulting list can be browsed by file type, and you can 'zap' individual files or a whole bunch of them based on specific criteria (such as path, date, or whether they're originals or obvious copies). File analysis can take some time — on our 50GB Home folder, it laboured away for about ten minutes before presenting results. But its suggestions regarding duplicates seem accurate, and are based on the file structure itself, rather than just file names. The app lacks the granular controls of some rivals, but it's more user-friendly overall.

App Store » iOS APPS

Adobe Photoshop Mix

Another step forward for iPad photo editing?

FREE | ADOBE | MIX.ADOBE.COM

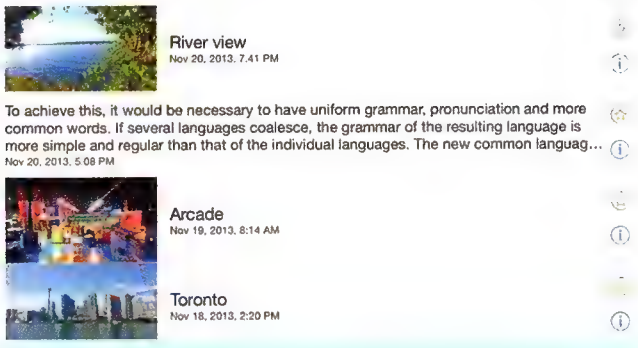
Adobe Photoshop Mix's tools let you make basic edits to photos, making the most of similarly powerful tech to that lurking at the heart of the full desktop powerhouse, Photoshop. There are filters, enhance tools and cropping options, and you can cut out part of an image and overlay it on another as a very basic collage. The smart edge-finding capability is reasonable at its job, but fine-tuning is clunky.

One of the headline features is Content-Aware Fill, an incredibly powerful tool from the desktop version of Photoshop, and there are also upright and shake reduction tools. These are also variable in their results, though, and are actually powered by Adobe's servers, meaning they require a fast web connection to send/receive the data from Adobe. They may also eventually be hidden behind IAP or Adobe's Creative Cloud subscription.

Sticking with the theme, the gestural interface used to

control many options in the app is itself a mix – sometimes wonderful (zoom/twist) and maddening, with the undo function being almost impossible to trigger.

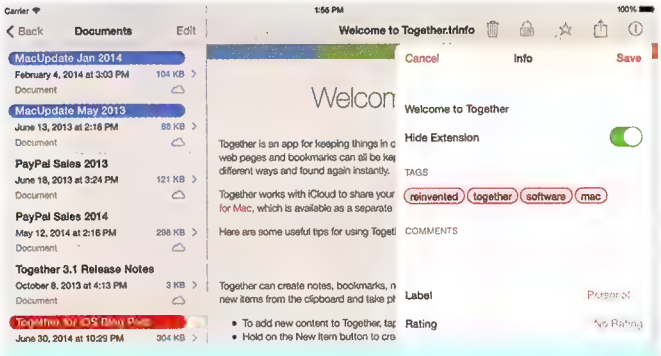
The underlying technology in Photoshop Mix is undoubtedly impressive, and the idea of having tools such as Content-Aware Fill available on the iPad is hugely desirable, but it's hard to see who Mix will appeal to right now. It's still too limited for real pro use, and most amateur Photoshop users are unlikely to use Creative Cloud.


River view
Nov 20, 2013, 7:41 PM
To achieve this, it would be necessary to have uniform grammar, pronunciation and more common words. If several languages coalesce, the grammar of the resulting language is more simple and regular than that of the individual languages. The new common languag...
Nov 20, 2013, 5:08 PM
Arcade
Nov 19, 2013, 8:14 AM
Toronto
Nov 18, 2013, 2:20 PM

Smart Copy

$2.49 | LUKAS ROSSI | WWW.APPDIMENSIONS.COM

Copy and paste didn't appear until the third version of iOS, and it hasn't changed much since — a feature Smart Copy hopes to reinvigorate with this inexpensive clipboard history manager. Text, images, and other data up to 10MB are automatically saved any time Smart Copy is opened, and can be moved back to the clipboard with just a tap. There's also a background mode, but it only works for 10 minutes at a time, due to Apple's restrictions. Content can optionally sync via iCloud, although we found this feature wasn't always reliable. Frequently used clipboard items can be saved as Favorites, and Smart Copy can convert to plain text, stripping away unwanted formatting. In all, it mostly delivers on being an iOS clipboard manager, despite being hamstrung by iOS.



Together Mobile

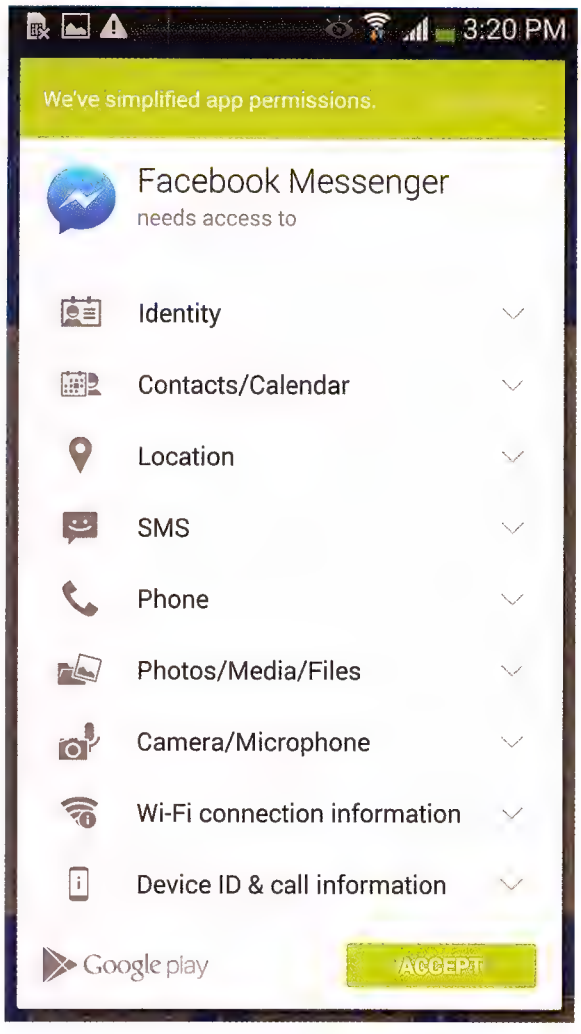
$12.99 | STEVE HARRIS | REINVENTEDSOFTWARE.COM

The storing of links, shortcuts and other content in a single location has been easy on Windows and Mac PCs for decades, but on iOS, Apple only really provides the Notes app. Together Mobile is a repository for links, notes, bookmarks, pictures and even movies, and supports rich as well as plain text. You can create multiple libraries, tag, label, sort and manage lists with ease and everything can be synced via iCloud, with an optional extra app. It's slick and elegant and works well, though you have to enter all the information manually inside the app. When iOS 8 introduces app extensions, you should be able to save content from other apps directly, which will make it much more convenient. As it is, this is a good way to store and sort content for power users who take lots of cuttings.

Facebook Messenger

Unbundling Facebook proves divisive, both literally and figuratively.

FREE | FACEBOOK | TINYURL.COM/D2C3L6O



Well, they've really gone and done it this time. Facebook has removed one of the key things that made it useful: messaging. It argues that its separate, standalone messaging app, Facebook Messenger, is a quicker, better way of getting in touch, and so has started blocking the messaging functionality in the primary Facebook app. This move would have always been unpopular – after all, it's inconvenient to have to maintain two separate Facebook apps where one used to suffice – but an internet-borne moral panic, stemming from web reports that Facebook Messenger's permissions will trample all over your privacy, certainly hasn't helped sell the launch.

For its part, Facebook maintains that they're the same permissions that all its apps require and puts the controversy down to user misunderstanding over Android's policy of requiring you to OK all app permissions in one hit on installation (which *does* make the app kind of look like its creepily hell bent on taking over your device). But whether it's the perceived privacy ramifications or just broad resentment at having to play along the division has been... divisive. As noted by commentators online, Facebook Messenger is currently the #1 app on the iOS App Store, but it's woefully tanking in the ratings department (with a disastrous 1.5 star score in the Australian App Store at time of writing).

Google Now Launcher

FREE | GOOGLE | TINYURL.COM/L6X6V93

At some point Google realised it could exert a much greater degree of sway over the increasingly fragmented, vendor-led Android ecosystem if it focused on giving users direct access to the latest core Google services and updates through primary Google Play apps, rather than incorporating them as highlight features of major OS upgrades — which, as any Android user will readily tell you, sadly don't come around too often, due to the fractured, staggering way the Android updating process works (involving much back-and-forthing with OEMs and telcos). And so thus we have the Google Now Launcher, which on the face of it is just a nifty way to get Google Now one swipe away (which is pretty cool) and touch-free Google voice search on your homescreen (which is *really* cool). But more is going on here. Because Google Now Launcher is a whole launcher alternative, this is also actually an incredibly easy way of degunking that nasty skin your Samsung/Sony/HTC (and so on) came with, replacing it with a much neater, simpler user interface — the very kind that Google puts on its home-baked Nexus and 'Google Play Edition' devices. And hey, if you don't like it, it's easy as pie to revert to TouchWiz and friends. But after sampling GNL's excellent mix of minimalism and handy features, we have a feeling most of you won't be switching back. Just one caveat, folks: requires Android 4.1 or later.

Windows Store » WIN PHONE 8

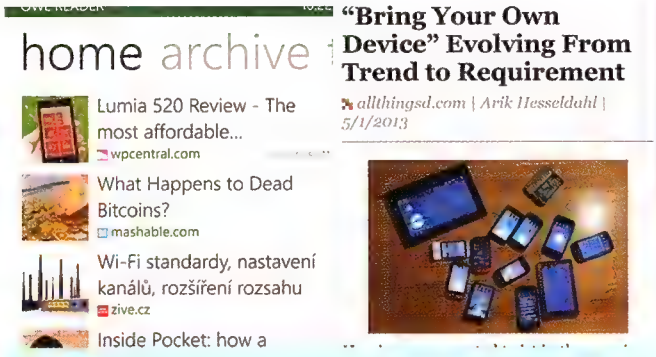
Flappy 2048 3D

Will Flappy ever just die?

FREE (WITH IAP) | STARSHIP STUDIO | TINYURL.COM/NJJ7ZC8

Ladies and gentlemen, without further ado, we present to you everything that's currently wrong with the state of mobile software, consolidated into a single app: *Flappy 2048 3D*. Yep, if the name didn't give it away, this unholy mish-mash of a concept strives to glue together two hit games from recent times – *Flappy Bird* and *2048* – resulting in a desperate, ill-advised mess.

Clones and cash-ins don't get any more 'meta' than this. And there's poor collision detection to boot! Microsoft recently announced Windows Phone's app store has passed the 300,000 title milestone. It's an accomplishment, sure, and it shows that developers are at least turning up to the party. But it's not a lack of apps that's the issue for the platform any more – it's the state of the catalogue that does exist. App users don't want hundreds of thousands of crappy choices; they want fewer choices between items of recommendable quality. Far better to pick between 300 amazing apps than 300,000 turkeys. Not that the even fatter App Store or Google Play are any better, mind you – they too are teeming with a surplus of filler. (Including *Flappy 2048 3D*, just FYI.)


home archive
Lumia 520 Review - The most affordable...
wpcentral.com
What Happens to Dead Bitcoins?
mashable.com
Wi-Fi standardy, nastavení kanálů, rozšíření rozsahu
zive.cz
Inside Pocket: how a
"Bring Your Own Device" Evolving From Trend to Requirement
allthingsd.com | Arik Hesseldahl | 5/1/2013

Owl Reader

99C | XPERIENSIS | TINYURL.COM/KYO3GKM

In lieu of an official Pocket client for Windows Phone, WP users of the read-it-later service needn't despair, as there's a number of solid third-party alternatives. The well-regarded Poki, which we've previously covered, and Pouch both sell for $1.99, but Owl Reader offers a similar feature set for just half that. Owl Reader gives you offline reading for any items stored in your Pocket unread list, a number of different reader themes, bulk item editing and tagging, a huge range of advanced visual settings, sharing functions and view-in-browser, plus support for landscape orientation. The free trial isn't limited in any way and doesn't even include ads, but buying the full version rids you of occasional pop-ups.

Badland

$1.99 (FREE TRIAL AVAILABLE) | FROGMIND | TINYURL.COM/KWYWS5K

Unlike *Flappy 2048 3D*, here's a game that does almost everything right with a conceptually similar side-scrolling premise: lush silhouetted visuals, evolving landscapes and gameplay plus puddles of atmosphere and character. *Badland* made a splash on iOS and Android last year and the award-winning arcade puzzler is now available on Windows Phone. You've got to fly your creature(s) to the end of each level, avoiding all manner of whirring, stomping and rolling death in your way. What starts off as a simple dodging exercise becomes quite a challenge in later levels, and you'll be forced to make some hairy decisions — including sacrificing some or most of your flock. Tough love.

FORGET PS4 & XBOX ONE

CONSOLE KILLER!

BEAT THE CONSOLES WITH A LOW-COST GAMING RIG, OR OUTCLASS 'EM WITH CUTTING EDGE PC TECH!

It probably won't come as a surprise that we're fans of the PC here at *APC* mag — 'PC' is, after all, in our name. But when it comes to gaming, the PC has long been considered the expensive option because the price of entry was a $1,500 plus gaming rig.

This month, we've shown that that needn't be the case, putting together two 1080p gaming-ready rigs — one from AMD and one from Intel — for $600; around the price of a new PS4 or Xbox One bundle. If you or someone you know has always wanted to build a PC-gaming rig for less, now is honestly the best time ever to break out the screwdriver and show 'em how. You'll end up with a machine that can play all the latest games at Medium detail levels, and often higher. There are plenty of reasons, besides just visuals, to love gaming on PC.

CHEAPER GAMES

Gaming PCs may have historically been more expensive than their console cousins, but one plus is that the games, on the whole, are cheaper on PC. Games that cost $100 on a console at launch can often be had for $80 (or far less in some cases) on PC. Buy four major games a year and you've saved enough to afford a fifth!

New releases, however, are just the tip of the iceberg. Head along to Steam's bi-yearly sales and you can pick up games for 75%+ off. Then there's the bundle scene, with sites packaging together five or more titles into a bunch that can cost you less than $10.

MORE VARIETY

Over the last 5 years or so, the rise of indies has changed the face of gaming as we know it — and the PC is right on the front line of this. While there've been a handful of console-exclusive indies, almost all of these have subsequently launched on PC — usually in bigger and better versions.

DITCH THE DRM

Owning your games outright has become something of a murky prospect in this age of digital downloads, but the PC still offers gaming with the fewest strings. Many indies (and even some of the big guys — like *The Witcher* series) have ditched DRM and offer their games DRM-free from their official web site or via Humble Bundle (**www.humblebundle.com**) and on **GoG.com**. The latter also offers a huge range of DRM-free classics too, so you can revisit all your old favourites — or introduce them to a new generation of gamers.

The extra detail added to games like *Battlefield 4* by 4K makes it the perfect technology for gamers; it's just a pity about the hardware requirements.

4K vs G-Sync: The next-gen display techs have landed

Bennett Ring round-ups the first batch of truly affordable 4K displays and pits two brand-new G-Sync screens in a head-to-head battle for silky-smooth gameplay.

Walk into any retail outlet and you'll notice that today's HDTVs are already a dying breed, with a new type of TV promising to revolutionise home cinema. 4KTVs, also known as Ultra High Definition TVs (or UHDTVs), quadruple the res of HD screens up to a whopping 3,840 x 2,160. There's just one problem – unless you've got the eyesight of a hawk, this increase in resolution is actually very hard to notice at normal TV viewing range. It only starts to become noticeable if the screen is huge, between 80- and 100-inches, making the technology a bit of a gimmick in standard 65-inch panels.

Thankfully there is another use for all of these extra pixels. PC users sit much closer to the screen than home theatre audiences, and at this close range the human eye can detect the increase in resolution with 4K. It's obviously more noticeable the larger the screen is, and over the last few months we've seen the trickle of affordable 4K PC displays turn into a healthy stream of new products. Computex 2014 also revealed the use of 4K screens in a handful of upcoming laptops. So who should consider a 4K display, and what are the pros and cons of these crisp new screens?

Gamers seem to have a 4K crosshair drawn on their foreheads. It makes sense, as gamers are always chasing improved graphics. The increase in resolution makes games look crisper and more detailed than ever, and PC games are one of the few sources of 4K content that is widely available; getting hold of a 4K video in Australia is like trying to get blood out of a stone. There's a price to be paid for all of this 4K gaming content though; as you'll see in a moment, 4K gaming requires a huge leap in graphics performance.

3D artists and 2D image editors will also benefit from the leap in resolution, with the extra clarity making it easier to work with visual content. There is a dearth of native 4K video content at the moment, but owners of new DSLRs that can shoot in 4K will also benefit from the leap in resolution. Finally, users who need to display multiple windows on-screen simultaneously will benefit from the higher resolution, though Windows' default font settings can make it hard to read text from afar.

4K GETS AFFORDABLE

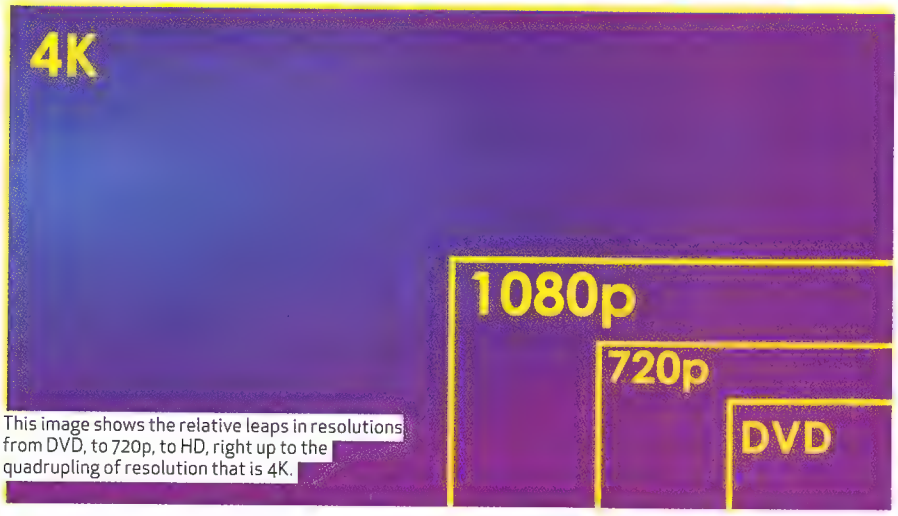
The first wave of 4K screens were plagued with driver issues and compatibility problems, but these seem to have been ironed out. However, there are still a handful of problems that exist with 4K. The first of these is the refresh rate of certain screens, which can be limited to just 30Hz when displaying the native 4K resolution. This is far too low for gamers or even desktop users, making the PC feel sluggish. Even just moving a mouse cursor at 30Hz feels off, limiting these displays to viewing 4K videos at 24Hz; for other uses you'll need to drop the resolution to increase the refresh rate.

Another issue is the basic image quality of these screens.

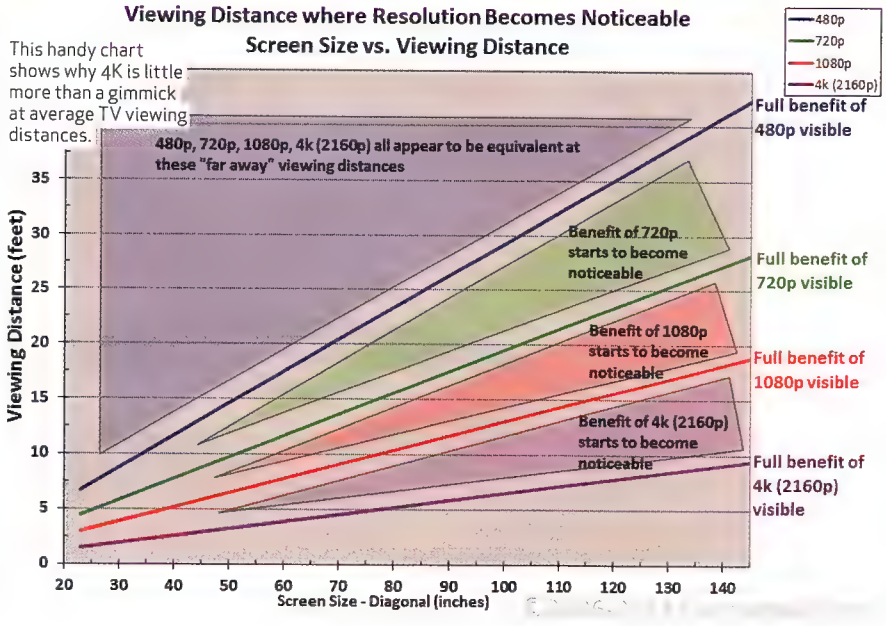
Even AMD's water cooled behemoth, the R9 295X2, struggles to deliver playable performance at 4K with everything set to maximum detail.

4K performance issues aren't unique to AMD — even two of Nvidia's fastest GTX 780 Ti cards couldn't handle the load of maximum image quality at this resolution.

"Manufacturers are trying to squeeze more pixels in at affordable prices, and some have sacrificed colour accuracy and contrast performance in the process."



This image shows the relative leaps in resolutions from DVD, to 720p, to HD, right up to the quadrupling of resolution that is 4K.



This handy chart shows why 4K is little more than a gimmick at average TV viewing distances.

Manufacturers are trying to squeeze more pixels in at affordable prices, and some have sacrificed colour accuracy and contrast performance to do so. Most 4K displays use cheaper TN panels, with IPS being a rarity. The good news is that this is becoming less of an issue as the technology matures, with many of these screens having downright impressive specs, regardless of the resolution.

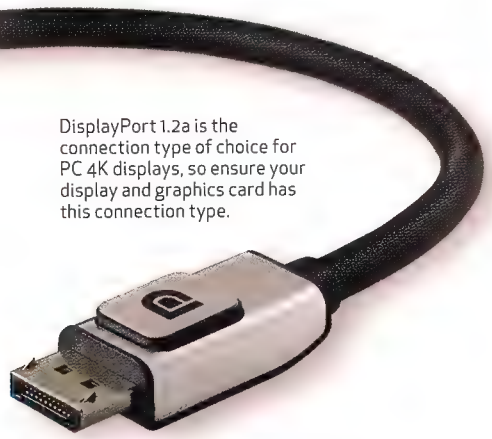
A GPU TORTURE TEST

Quadrupling the number of pixels on-screen obviously places heavy demands on the PC's graphics cards, so we ran a series of game benchmarks to see just how much more performance is required for 4K gaming. We grabbed the top two GPUs from AMD and Nvidia, in the form of the R9 290X and GeForce GTX 780 Ti, and set them up in twin-GPU systems with an Intel i7 4770 CPU overclocked to 4.5GHz. 16GB of DDR3-1800 memory was paired to the CPU, while a Samsung 840 SSD provided storage space. We also tested with AMD's new uber card, the R295X2, which is basically twin R9 290X GPUs on a single card. Even with these incredibly powerful, dual-GPU systems doing the heavy lifting, we failed to reach playable performance in our benchmarks with maxed detail levels. Every game failed to hit the 60fps minimum that gamers aspire to, but lowering the graphics options to medium made a huge improvement. At 4K res but medium detail levels, all of the games were playable, so we also tested a more affordable GeForce GTX 760 at this setting. Sadly this $275 card couldn't manage 4K even on medium. We have to conclude that 4K gaming is currently limited to the hardest of the hardcore PC gamers.

There is a silver lining in this cloud of doom and gloom though — Nvidia's G-Sync technology smartly sidesteps the issue of minimum frame rates. Read on to see how it works, and why it could be the answer to affordable 4K gaming in the near future.

Setting up your 4K screen

How to optimise your hardware and software setup to get the most from a 4K screen.



DisplayPort 1.2a is the connection type of choice for PC 4K displays, so ensure your display and graphics card has this connection type.

The early days of 4K displays proved to be extremely poor from a user's perspective, with a range of problems making the technology more trouble than it was worth. Thankfully most of these issues have since been resolved, though it's still not entirely trouble-free. As our gaming benchmarks show, some games simply won't run at 4K, with our twin GTX 780 Tis crashing during the *Hitman Absolution* benchmark. Issues like this are in the minority though, and if you follow our recommendations, getting your 4K display up and running should only take a few minutes.

THE IMPORTANCE OF INPUTS

By far the most crucial factor to consider is the connection method between the graphics card and the 4K display. The PC market seems to have settled on DisplayPort for 4K, with DisplayPort 1.2a providing the necessary bandwidth to run 4K at 60Hz. This is in stark contrast to the 4KTV market, which is going with HDMI 2.0 connections instead. If you were planning on hooking your 4K gaming PC to a 4K TV, this could be a deal-breaker, as there aren't any mainstream gaming graphics cards with HDMI 2.0 outputs, and there are only a handful of 4KTVs with DisplayPort inputs.

It's worth pointing out that most 4K PC displays have a setting which allows their DisplayPort to run at either 1.1 or 1.2 mode; if you can't change the refresh rate from 30Hz (see below), chances are you're running the display's DisplayPort in 1.1 mode – search through the menu for an option to change it to 1.2. How to do so will vary depending on the display. Note that many 4KTVs include several standard HDMI 1.4a inputs, but these are limited to 30Hz at 4K, making them unsuitable for 4K gaming or 2D use, limiting them to 4K video playback.

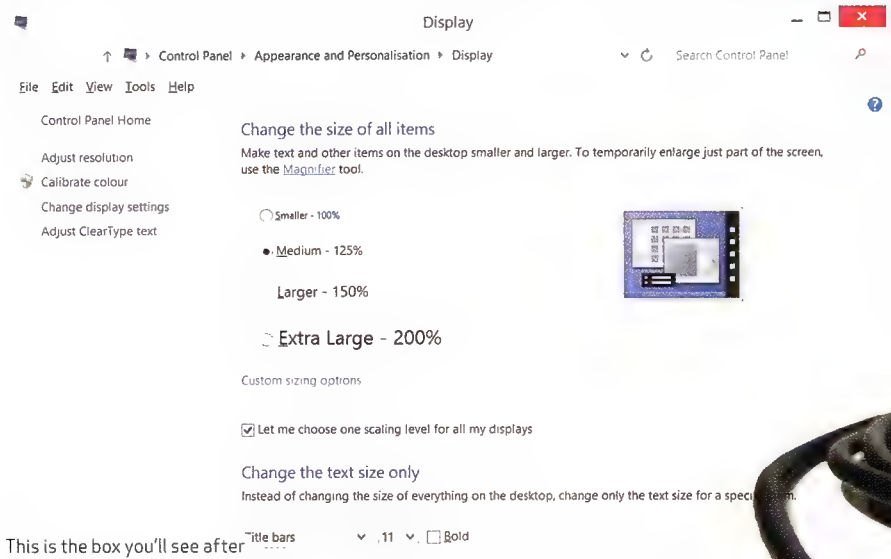
CHECK YOUR RESOLUTION AND REFRESH RATE

When you first set up your 4K display, there's a good chance that it will default to a lower resolution and refresh rate. To ensure it's running at the optimal settings, right click your desktop and click 'Screen resolution'. If you're running multiple displays, click on the 4K display in the main window, and check that the Resolution is set to 3,840 x 2,160. If not, change it and click Apply. Your screen will probably flick off then come back on at the new setting – a Windows pop up box will ask you to verify the new settings; if you don't click Yes, it will revert to the former resolution.

Now that you've got your screen running at 4K res, it's time to check it's running at a smooth 60Hz refresh rate. If you've closed your 'Screen resolution' box, open it again by right clicking the desktop and selecting this option. Now click on 'Advanced Settings', then check the Monitor tab in the new window. You'll see a drop-down option for 'Screen refresh rate:'. Check that this is set to 60Hz; if it's not, change it to 60Hz and then hit apply. Once again Windows will give you 15 seconds to verify the change. Note – if you only have the option to run the display at 30Hz, you'll need to search through the display's menu for an option to change the DisplayPort mode from 1.1 to 1.2, as mentioned earlier.

FONT SIZE

Unless you're running a very large 4K screen, Windows' default font size is a little small on a 4K display. It's very easy to change though. We're assuming you're using Windows 7 or Windows 8 with a Windows 7 Start Button mod; simply click the start button and type 'font size' into the search box. One of the search results will be 'Make text and other items larger or smaller' – click this. You'll now be presented with a screen that says "Change the size of all items"; we suggest trying both 125% and 150% to see which you prefer. Note that you'll have to log out and back in to see the changes. Unfortunately it doesn't uniformly change text size across all applications, so you'll have to change your apps' font size and games' HUD size on a case by case basis.


Display
Control Panel ▸ Appearance and Personalisation ▸ Display
Search Control Panel
File Edit View Tools Help
Control Panel Home
Adjust resolution
Calibrate colour
Change display settings
Adjust ClearType text
Change the size of all items
Make text and other items on the desktop smaller and larger. To temporarily enlarge just part of the screen, use the Magnifier tool.
Smaller - 100%
Medium - 125%
Larger - 150%
Extra Large - 200%
Custom sizing options
Let me choose one scaling level for all my displays
Change the text size only
Instead of changing the size of everything on the desktop, change only the text size for a spec
Title bars
11
Bold
u use one scaling level, some items might be different sizes on different displays.

This is the box you'll see after selecting the "Make text and other items larger or smaller" option. We went with a 125% size increase on our 30 inch-4K screen.

4KTVs seem to be using HDMI 2.0 as their connection type of choice, making it a pain to hook up your 4K gaming PC to a compatible TV.

- 4 X USB PORTS (2 X USB 2.0, 2 X USB 3.0)
- 10.95KG WEIGHT
- WALL-MOUNT COMPATIBLE.

$639 | WWW.AOCMONITORAP.COM/ANZ/

AOC U2868PQU

4K at a 2K price.

If you ever needed proof that 4K prices are plummeting, the AOC is it. Widely available for just $639, it's a huge price drop compared to the 4K screens of just twelve months ago.

The exterior bezel isn't anything to write home about; it's relatively thick compared to designer LCDs, but at least it's extremely manoeuvrable thanks to the height and angle adjustable stand. The on-screen display (OSD) is accessed via front-facing touch buttons, making it very easy to navigate. There's a decent range of options for tweaking, if not quite as detailed as those required by professional image editors.

The range of inputs on the rear includes DisplayPort 1.2a, Dual-link DVI, and HDMI. The native resolution of 3,840 x 2,160 is paired with a 60Hz refresh rate, making this perfect for gamers. The fast 1ms pixel response time delivered a smear-free gaming experience, and we were also pleasantly surprised by the colour accuracy tests, with overall excellent accuracy. The contrast ratio was slightly higher than anticipated as well, while luminance was just under the expected result of 120cd/m2. The one trouble spot was screen uniformity, with several of the corners of the screen around 20% dimmer than the centre.

It's slightly noticeable in desktop use, but the AOC isn't alone with this issue.

We walked away very impressed by this display; it seems AOC has managed to deliver an affordable 4K screen without compromising too much on image quality. It might not have the sexiest physical presence due to the plain bezel, but as far as value for money goes, this is the 4K display to beat.

Verdict

4K is truly affordable thanks to this wallet-friendly panel, which hasn't sacrificed quality for value.

- 10-BIT COLOUR
- 157 PIXELS PER INCH
- 1MS PIXEL RESPONSE TIME

$799 | WWW.ASUS.COM/AU

ASUS PB287Q

One of the first affordable 4K displays to arrive.

ASUS was one of the first to release 4K monitors less than a grand, with the PB287Q. It's been on the market for a few months now, so we're surprised that it's one of the more expensive models in the roundup; by now prices should have dropped to remain competitive with the new breed of displays.

Like its brethren, this 28-incher runs at a native 3,840 x 2,160, with a refresh rate of 60Hz, delivered courtesy of DisplayPort 1.2a. It's built around a TN panel, like all of the monitors in this roundup bar one. The bezel is designed to be functional rather than fancy, with old fashioned push-buttons on the rear of the screen used to access the detailed calibration options. We highly advise using these settings, as out of the box this screen has the brightness cranked up well over 200cd/m², washing out colours and blowing out the contrast. Even setting it to sRGB mode was too bright, so we changed to the "user" preset to manually lower brightness. We dropped this back to 120cd/m² for our colorimeter tests, and measured relatively average colour quality. Contrast was also middle of the pack. One final issue was a slight halo around fonts and icons on the Windows desktop.

Once again we see the manufacturer claiming a 1ms pixel response time, and once again we failed to see a trace of motion blur during our gaming tests. These 28-inch 4K displays really are very similar when it comes to image quality.

Instead most buyers will be influenced by the price and features, and in this regard the PB287Q loses out to its newer, cheaper competitors. Hopefully ASUS drops the price in the near future, putting it back on an even keel with its rivals.

Verdict

The original is no longer the best, with competitors offering more features at lower prices.

- 99% ADOBE RGB AND 100% SRGB COVERAGE
- IPS PANEL
- ULTRAWIDE VIEWING ANGLE OF 178 DEGREES

$1150 | WWW.DELL.COM/AUSTRALIA

Dell UltraSharp UP2414Q

One for the professionals.

Measuring just 24 inches, the UP2414Q is significantly smaller than its rivals. Yet the price tag is almost twice the cheapest display. Dell has a reputation for premium displays that cost more, but this price hike does seem a tad excessive.

We love the aluminium stand, but the plain black bezel isn't as impressive. At least it's got front-facing touch controls, delivering easy access to Dell's detailed range of image calibration options. On the rear of the display is the usual DisplayPort 1.2a port, alongside another mini-DisplayPort and a single HDMI port.

Our testing encountered a major obstacle, with the screen entering power saving mode whenever we tried to test with DisplayPort 1.2 enabled. Changing the DisplayPort to 1.1 mode allowed us to run the full gamut of the tests, and it was definitely worth the effort. Dell has set the brightness to scorching high levels out of the box, but once calibrated this monitor is in a league of its own when it comes to colour reproduction. Even the maximum variance was insignificant, while the overall colour variance was basically non-existent. Interestingly the contrast performance was middle of the pack, but Photoshop editors will be more concerned with the colour reproduction.

Despite the incredible colour performance, we're still concerned about the price vs the size. Users will basically need their eye-lashes to caress the screen to notice the increased resolution, and the issue of tiny fonts in programs that don't support font scaling will be a real problem. Still, if you demand the ultimate in colour quality, Dell once again proves it's the colour quality king.

Verdict

Costing twice the price for a much smaller screen, the Dell is saved by its amazing colour reproduction.

★★★★½

- 1MS PIXEL RESPONSE TIME
- SMARTRESPONSE COMPATIBLE
- 2 X USB 2.0, 2 X USB 3.0 PORTS.

$759 | WWW.PHILIPS.COM.AU

Philips 288P6

Philips aims at the budget pack.

4K still has a few rough edges to sort out, as we discovered with this Philips screen. When we first plugged it in, we couldn't figure out why it wouldn't run at more than 30Hz, especially as a large onscreen prompt kept telling us that it would be optimal to run the screen at 60Hz. It was only after digging through the cryptic interface that we found a setting for the DisplayPort specification – changing this from 1.1 to 1.2 enabled the higher refresh rate. Little issues like these makes 4K less attractive to the mainstream, yet nearly all had the same problem.

At $759 this is still a remarkably affordable display considering the resolution, but it's obvious little expense has been spent on the exterior. Like the AOC, it offers a native 3,840 x 2,160 display at 60Hz, stretched across 28 inches of viewing space. A very plain bezel and stand are included, though the flexible stand allows for height and angle adjustment, as well as portrait and landscape mode. All the usual connections are included – DisplayPort 1.2a, HDMI 1.4a and Dual-link DVI.

Image quality proved almost identical to the AOC display, especially regarding colour accuracy and contrast ratio. It performed slightly better in the uniformity tests though, with the corners averaging around 10% dimmer than the centre, which was definitely less noticeable during use. The pixel response time is rated at 1ms, identical to the AOC, but our gaming test seemed to show a little more motion blur than the AOC.

Considering this display delivered almost identical performance and features to the AOC, but for $100 more, we're hard pressed to come up with a compelling reason to shell out the extra cash.

Verdict

Offers remarkably similar performance and features to the AOC, just costs more.

★★★★☆

- PICTURE IN PICTURE SUPPORT
- GAME MODE
- TWIN HDMI 1.4 AND 1 X DISPLAYPORT 1.2A

$650 | WWW.SAMSUNG.COM/AU

Samsung U28D590

Style over substance.

The importance of calibrating your display can't be understated, as the Samsung U28D590 illustrated perfectly. Setting it up straight out of the box revealed a brightness level that glared like a small sun, cranked to retina-scorching intensity. Our colorimeter measured it at 228 cd/m², almost double the recommended 120cd/m² that is standard amongst displays. We lowered the brightness to 120cd/m² to compensate, and were rewarded with a much more palatable image to view.

Samsung has decided to go for style over substance with its immovable stand. It sure looks pretty; it's just a pity that it can't be adjusted in the slightest. It's also a surprisingly deep display compared to the competition, and the position of its rear inputs makes it impossible to wall mount.

The menu system is also relatively rudimentary, using a rear-mounted joystick to navigate.

Once we'd tamed the obscene brightness, the U28D590 turned in some impressive numbers. In particular, it had some of the best colour accuracy scores of the roundup, with excellent results for a TN panel. However, the native contrast ratio wasn't anything to write home about, coming in at 736:1. Screen uniformity also proved to be a sticking point, with the top right corner 25% dimmer than the centre of the screen. As a result, games looked a little dark in certain spots, which could be why Samsung cranks the brightness so much at default, though there was no discernable motion blur.

Despite the ridiculous out-of-the-box brightness, Samsung has delivered a display that is exceptional at colour reproduction once calibrated, yet merely average at everything else. Whether or not it's the display for you will depend entirely on your need for accurate colours.

Verdict

Excellently priced considering the great colour accuracy, a shame the rest has been compromised.

★★★½☆

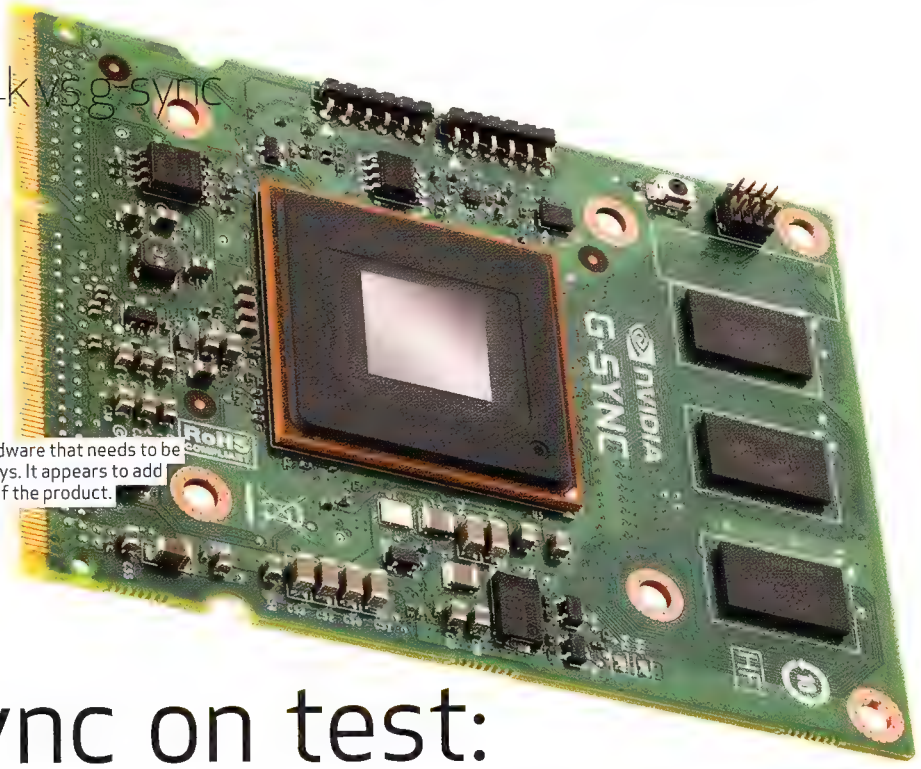
LABS RESULTS: GAMING AT 4K

	AMD RADEON R9 290X X 2 (CROSSFIRE)	NVIDIA GEFORCE GTX 780 TI X 2 (SLI)	AMD RADEON R9 295X2	NVIDIA GEFORCE GTX 760
METRO 2033 @ MEDIUM DETAILS (MIN/AVG FPS)	23/52	25/55	25/55	8/20
METRO 2033 @ MAXIMUM DETAILS (MIN/AVG FPS)	7/23	8/24	9/26	DNR
BATTLEFIELD 3 @ MEDIUM DETAILS (MIN/AVG FPS)	70/98	63/90	76/106	24/32
BATTLEFIELD 3 @ MAXIMUM DETAILS (MIN/AVG FPS)	50/59	38/52	54/64	DNR
HITMAN ABSOLUTION @ MEDIUM DETAILS (MIN/AVG FPS)	70/81	76/85	77/87	30/34
HITMAN ABSOLUTION @ MAXIMUM DETAILS, 4XAA (MIN/AVG FPS)	41/49	CRASHED/CRASHED	44/55	DNR

LABS RESULTS: 4K DISPLAYS

	NATIVE CONTRAST RATIO	LUMINANCE*	STANDARD DEVIATION^	AVERAGE AE^	MAXIMUM AE**
AOC U2868PQU	816:1	119	1.41	1.53	7.45
ASUS PB287Q	782:1	119 (202 BEFORE CALIBRATION)	1.3	1.7	7.35
DELL UP2414Q	770:1	120 (220 BEFORE CALIBRATION)	0.31	0.64	1.65
PHILIPS 288P6	812:1	120	1.33	1.13	7.28
SAMSUNG U28D590	736:1	119 (228 BEFORE CALIBRATION)	1.07	1.29	6.02

* CALIBRATED, MEASURED IN CANDELAS PER SQUARE METRE (120 IS OPTIMAL)
^ ALL PATCHES COLOUR DEVIATION (5 IS AVERAGE, LOWER IS BETTER)
** WORST PATCH COLOUR DEVIATION (5 IS AVERAGE, LOWER IS BETTER)



This is the dedicated hardware that needs to be installed in G-Sync displays. It appears to add around $100 to the cost of the product.

G-Sync on test: 4K's saviour explained

Not quite convinced on 4K yet? Nvidia's G-Sync is a potential game-changer for 4K gaming — and 1440p monitors using it are already available. Bennett Ring puts them to the test.

Originally announced in late 2013, it's taken almost another full year for Nvidia's proprietary G-Sync display technology to arrive on store shelves. Supported by all of Nvidia's current GPUs from the GTX 650 upwards, G-Sync also requires special G-Sync monitors, which have the necessary hardware involved. So, just what does it do, and why is it especially relevant to 4K screens?

Today's GPUs are slaved to their monitor's refresh rate, which is why most gamers use vertical synchronisation to enable a stable, clear image. This comes at a cost though — if the game's frame rate ever drops below 60 frames per second, V-sync can incur heavy performance drops due to the way it works, sometimes even halving the frame rate of a game. The alternative is to disable V-sync, but this results in an issue known as screen tearing, where two frames are displayed on screen during a single screen refresh. It's left gamers in a quandary — no matter which option they choose, there are compromises. V-sync requires powerful hardware, even more so at 4K resolution, to maintain the 60 fps minimum frame rate, while disabling V-sync results in an unstable image.

G-Sync simply reverses the relationship between the display and the GPU, slaving the display to the GPU's output. As a result, the screen will only refresh when the GPU has a new frame ready to go. Nvidia has had to get intimately familiar with LCD screens to figure out how to make them run at dynamic refresh rates, but the benefit is huge. Firstly, the frame rate can alternate anywhere between 40 frames per second and upwards, and the image remains stable and smooth. Drop below 40 frames per second and motion blur becomes an issue, but it's already lowered the hardware requirement for smooth gameplay by 50% when compared to a 60 frames per second baseline. This fact alone makes G-Sync incredibly relevant to 4K display owners.

Secondly, it removes all of the issues encountered when V-sync is enabled or disabled. There is no performance drop when the frame rate goes below the screen's refresh rate, because the refresh rate is dictated by the GPU's frame rate. There's no screen tearing as the screen will never try to draw two frames into a single refresh. Even better, it lowers the latency between a player's inputs and the outcome on the screen, making it the superior way to play in every instance.

There's just one problem — it's owned entirely by Nvidia. Such a radical rethink of how displays should perform should have come from an industry open standard, such as VESA, the board behind display standards. Instead it was left to Nvidia to spend the time and money to come up with this technology, and they don't want to share it. If we look at every other Nvidia-specific technology, from PhysX to TSAA to 3D Vision, these have remained extremely niche techniques, only utilised by a handful of games. The good news is that G-Sync will work with every game, but the fact remains that owners will need both a G-Sync Nvidia graphics card and a G-Sync compatible monitor, so we're concerned it will remain a niche technology. Thankfully AMD is releasing a competing technology called FreeSync; whether or not this free and open display technique can live up to the benefits of G-Sync won't be fully known until it arrives at the beginning of 2015.

There aren't any G-Sync displays with 4K panels available in Australia as yet, but the two 1440p displays we've reviewed opposite perfectly illustrate the benefits of G-Sync. And for those happy to wait, they also nicely demonstrate what to expect when G-Sync lands in 4K territory.

Look for the G-Sync logo when building your G-Sync system; both the graphics card and the monitor need to be G-Sync compatible.

- 144HZ REFRESH RATE
- 8-BIT COLOUR
- 1MS PIXEL RESPONSE TIME

$999 | WWW.ASUS.COM/AU

ASUS PG278Q

This beautiful 27-incher is hard to beat.

It might only have a resolution of 2,560 x 1,440 (it's hard to believe we're saying 'only' when referring to such high resolutions), but this beautiful big-screen from ASUS is going to prove a hit with gamers. Offering a generous 27 inches of screen real estate combined with a roaring fast refresh rate of 144Hz, the added inclusion of G-Sync is the cherry on the top.

Straight out of the box, the baseline image quality of this display needs tweaking, as colours appear quite flat and lifeless. However, after a quick calibration the image is much more vivid, though it does suffer from the screen uniformity issues commonplace amongst 27- and 28-inch panels. The resolution is right on the edge of acceptable at close range, so we can't wait to see how a 4K version looks.

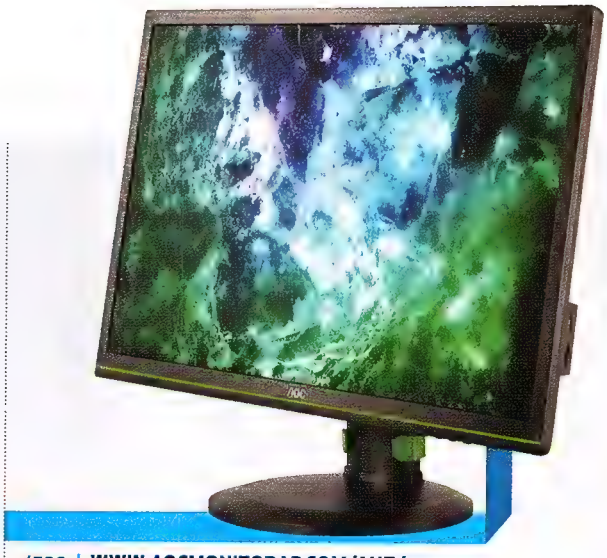
The real beauty of this display is the combination of a 144Hz refresh rate and G-Sync. This enables gamers with powerful systems to play around the 100fps mark without any screen tearing or performance drops, the price usually incurred by V-sync. Even when the framerate drops to 40 frames per second it still looks remarkably smooth and consistent, with just a hint of motion blur.

With a price tag right on a grand, G-Sync appears to be a rather costly inclusion in this first wave of products. Hopefully this will drop as more monitors appear, but until then the ROG PG278Q is the 27 incher of choice for demanding gamers.

Verdict

Gamers with fat wallets will find this hard to beat, it's one of the best big-screen monitors around.

- 1920 X 1080
- 144HZ
- 1 X DISPLAYPORT INPUT



$529 | WWW.AOCMONITORAP.COM/ANZ/

AOC G2460PG

G-Sync on a budget, apparently.

Costing over $500, this 24 incher from AOC is now the most expensive gaming display of this size, shuffling BenQ's gamer-range off the top-tier of cost. For the price you get a standard High Def screen with a resolution of 1,920 x 1,080, but with a scorching refresh rate of 144Hz and the added benefit of Nvidia's G-Sync. Compared to other 24-inch HD panels with a 144Hz refresh rate, which cost $400, we can see straight away that G-Sync has added at least $100 to the cost of the display, yet it's the most affordable G-Sync display on the market. Is it worth the premium though?

Unfortunately the answer to that question isn't clear, as this display seems to occupy an awkward middle-ground between performance and value. The screen itself offers a decent image quality, with no glaring faults in any of our colour or contrast tests. The onscreen display is a bit of a clunker, but at least the stand is highly configurable.

The ability to run without V-sync when paired with the 144Hz refresh rate will allow owners of high-end Nvidia graphics cards to play their games around the 100Hz mark without any image quality issues.

In the past this would have required at least twin GPUs, but G-Sync now enables this level of performance with a single GPU. However, we can't help but wonder if gamers are willing to pay this much for such a small screen with HD resolution? If AOC could shave another $100 off the price, it'd be on an even keel with other 24-inch premium displays, but at this price it's getting dangerously close to 27-inch prices.

Verdict

Hopefully the price will come down; until then, it's very expensive, even if it is the cheapest G-Sync panel.

The smart choice in SSDs

Samsung's EVO family of solid-state drives offer the most compelling mix of performance, price and capacity on the market.

SSDs have transitioned from niche products made for enthusiasts and professionals to something that every PC should have. As SSDs have aptly proved, traditional platter-based hard drives can be a huge bottleneck when it comes to performance, with today's SSDs offering up to five times the speed when it comes to reading and writing data — and many times that in more seek-intensive tasks, like the random reads and writes that make up most of our day-to-day computing tasks. In short, if you want a computer that not only boots up and loads apps quickly, but is also incredibly responsive, then an SSD upgrade is a must.

So which SSDs are the best-value proposition in today's market? There's a lot of competition from SSD makers (both big and small), but of all those, Samsung's EVO line of drives has the most persuasive range of products. If you need a big SSD, Samsung's EVO range features the largest consumer drives available, with models ranging up to a whopping 1TB.

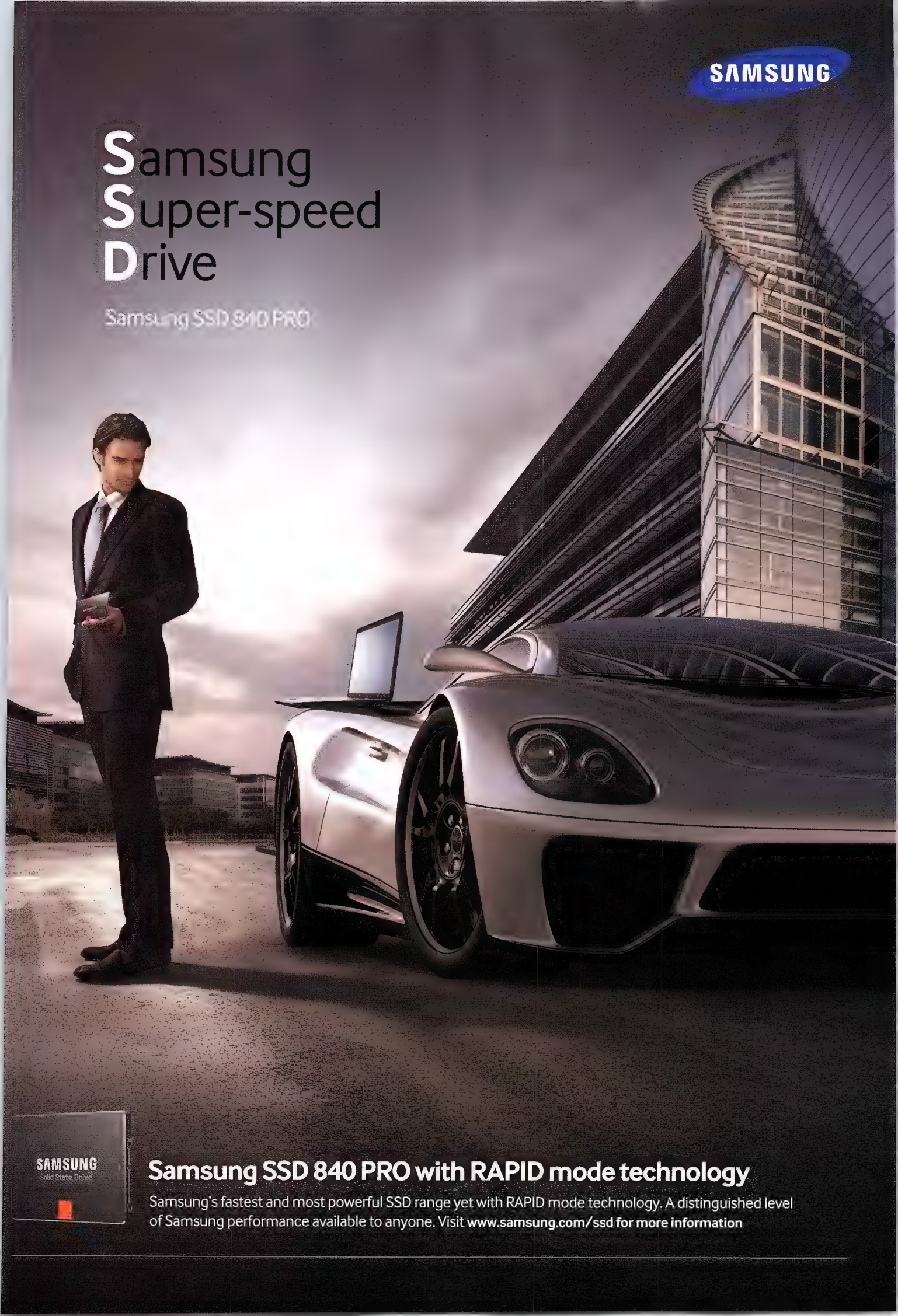
Feeling the need for speed? The EVOs consistently perform on-par with — and often better than — more-expensive drives from other SSD manufacturers. And that potent mix of capacity and speed isn't going to cost you an arm and a leg either — the EVOs are some of the best-value SSDs available and they can be scooped up for less than $1 a gig.

EVO drives also include exclusive technologies, such as Samsung's Magician software, which can make it easy to transition your PC or laptop from your old drive to your new EVO SSD. Magician also includes the innovative RAPID Mode, which detects frequently-used data and caches it to DRAM. This not only helps improve performance, but can reduce wear and tear on the SSD itself.

Samsung is an undisputed expert when it comes to flash storage. Its chips don't just end up in its own devices (including its popular Galaxy smartphones), but even in products from its major competitors. It's this level of integration that helps Samsung put together the most compelling SSDs currently available. Whether you're looking for an inexpensive way to upgrade your laptop's hard drive to turn it into a lightning-fast portable PC, or putting together the plans to build your next killer gaming rig, Samsung's EVO line up is the smart choice when it comes to SSDs.

The 840 EVO at a glance

Capacity
Up to 1TB (1TB = 1 trillion bytes)
Form Factor
2.5-inch
Interface
SATA 6Gb/s (Compatible with SATA 3Gb/s & SATA 1.5Gb/s)
Dimension (WxHxD)
100 x 69.85 x 6.80mm
Weight
Max 53g
Storage Memory
Samsung 19 nm Toggle DDR 2.0 NAND Flash Memory
Controller
Samsung 3-core MEX Controller
Cache Memory
Samsung 1GB Low Power DDR2 SDRAM
Application
Desktop PC & Laptop PC


SAMSUNG
Samsung
Super-speed
Drive
Samsung SSD 840 PRO
SAMSUNG
Solid State Drive
Samsung SSD 840 PRO with RAPID mode technology
Samsung's fastest and most powerful SSD range yet with RAPID mode technology. A distinguished level of Samsung performance available to anyone. Visit www.samsung.com/ssd for more information

The twin lenses are easy to see in this view. DK2 includes two sets of interchangeable lenses, to accommodate varying eye accuracy. Those who wear glasses are advised to use contacts.

Making the virtual into reality

In this Australian exclusive, Bennett Ring straps on the latest Oculus Rift DK2 headset to discover how far VR has come since the 1990s... and whether it's yet ready for prime time.

Virtual reality (VR) has been the holy grail of gaming since it first appealed to the mainstream imagination in the early 1990s, when films like *The Lawnmower Man* showed how immersive this new form of entertainment could be. Huge VR booths started showing up at gaming arcades, charging $20 for a five minute dip into these digital worlds, but gamers soon discovered that the experience was less than perfect. In fact, it was downright horrible, with nausea, headaches and neck-strain all common complaints after just a few minutes of wearing the bulky head-mounted displays (HMDs) of the past. VR faded from view, but it's about to make a comeback. Thanks to the passion of one man, combined with the mass availability of miniaturised components used in smartphones, virtual reality looks set to finally arrive in the next year, delivering on the promises made back in the 1990s.

PALMER GOT LUCKEY

Born in 1992 in Long Beach, California, Palmer Luckey showed an interest in electronics from a very early age. He was particularly interested in VR and the impact it would have on his passion

The Rift DK2 is slightly smaller than the DK1 thanks to the smaller screen, but it also includes an external camera for motion tracking.

Sony has the advantage of already having motion tracking of the player's hands and arms covered, thanks to the Sony Move controllers from the PS3.

for gaming, and started collecting consumer HMDs in his teen years. It became the world's largest private collection of VR headsets, with over 50 different units, but none of them delivered the experience Palmer desired. So in 2011 Palmer built his own VR headset, using a seven inch screen glued into a set of ski googles, attached to twin lenses. Unlike prior VR headsets, Luckey's approach utilised existing mobile technology to keep costs down, while delivering an image which filled the user's field of view. This primitive prototype was soon discovered by the Stephen Hawking of game programming, John Carmack, who was looking for a way to promote the re-release of his game *Doom 3* at 2012's Electronic Entertainment Expo. Carmack asked if he could borrow Palmer's prototype to conduct VR demos to journalists. After making a few small improvements, Carmack's VR demo became the talk of the show, winning several "Best of E3" awards, inspiring Luckey to take his VR concept to Kickstarter.

Thus Oculus VR was born, the company behind the Rift VR prototype. With an initial goal of $250,000 on Kickstarter, it went on to become one of the most successful Kickstarter projects of all time, raising $2.4 million in just 30 days in September 2012. As word of the device spread and funding started to roll in, Oculus started hiring some of the brightest names in the gaming industry. Brendan Iribe, formerly of Gaikai and Scaleform, joined as the company's CEO, while John Carmack left the company he founded, id software, to work as the CTO at Oculus. Valve's senior programmer Michael Abrash joined shortly thereafter as the Chief Scientist.

VR GOES MAINSTREAM

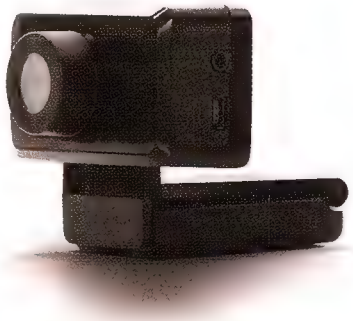
The first Rift Developer Kits (aka Rift DK1) arrived in early 2013. Aimed at enthusiasts and game developers, the DK1 proved that VR was finally possible at a price that consumers could afford, costing just US$300 per kit. After a year of development, in March 2014 Oculus announced the Dev Kit 2 (DK2), which would include several major improvements over the original prototype, including a higher resolution screen, better motion tracking, and a special low persistence screen. Shortly after, Facebook announced that it had acquired Oculus for US$2 billion worth of cash and Facebook stocks. As if March hadn't already revealed enough VR announcements, Sony then debuted its PlayStation 4 VR headset, codenamed Project Morpheus. It used the exact same technique to deliver VR, using a single screen split in half and viewed through special lenses, and has similar specs to the DK2. In the space of three years, VR had gone from failed dream to a platform being backed by some of the world's biggest brands.

THE DK2 — EYES ON

We were lucky enough to secure the first Rift Dev Kit 2 to land in Australia, and put it through its paces over a week to see just how far VR has progressed since the horrible *Dactyl Nightmare* game of the early 1990s. Despite some teething issues with software, by the end of the week we were convinced that VR is here to stay, though it will be several years before it's perfect.

The biggest improvement over the first Rift prototype is the screen resolution, yet this is also its greatest weakness. The DK2 uses a 1,920 x 1,080-pixel (1080p) OLED screen that is 5.6 inches across, a large resolution increase over the original 1,280 x

This is the position tracking camera that ships with the DK2. We used a camera tripod to mount it in front of a racing cockpit, but it will also clip onto monitors.



Oculus released this rendered image to give Kickstarter backers an idea of what the final consumer version might look like.

Samsung <3 Oculus

It seems Samsung and Oculus are best friends, with the DK2 using the Galaxy Note 3 screen, but the relationship is going to be even deeper moving forwards.

According to the internet rumour mill, the two companies have an agreement that sees Samsung giving Oculus early access to Samsung's mobile screen technology. In return, Samsung will release a head-mounted display based on Rift technology. However, it will focus entirely on media-playing, and will use a Samsung phone as a display, which can be slotted into the headset during use.

We're a little concerned that a media-focused headset will reach consumers before the proper Rift VR headset, as its limited functionality might muddy the VR waters. On the other hand, this relationship will give Rift access to screen tech that it would never be able to build alone, so hopefully the end result will be a better VR experience for everybody.

The folks over at **ifixit.com** pulled the DK2 apart, revealing the Samsung Galaxy Note 3 screen at the heart of the device.

> "With a refresh rate of 75Hz, movement is silky smooth. This is key to removing simulator sickness — anything lower and the user will start to feel nausea."

720-pixel (720p) display of the DK1. Closer examination reveals that it's the same screen found in Samsung's Galaxy Note 3, and even includes the cut-outs for the phone's home button and speaker. The screen is split down the middle, providing 960 x 1,080-pixels resolution per eye. This might sound relatively high, but each screen is viewed through a special lens that magnifies the screen, making it very easy to spot individual pixels. Games that aren't built specifically for the DK2 can be impossible to play, as the low resolution makes it difficult to read text or see finer details. We think that VR is going to need at least a 4K panel, and probably an 8K panel, before the pixel-visibility issue disappears. Thankfully, games that have been designed with the Rift DK2 in mind are highly playable, and the huge field of view means that the gamer is totally immersed in the experience. The DK2 fills 100 degrees of the user's field of view; it feels as if you're looking out into another world through a set of ski goggles, as the view is slightly cut off on the sides.

With a refresh rate of 75Hz, movement is silky smooth. This is key to removing simulator sickness — anything lower and the user will start to feel nausea. Another new feature that assists with removing simulator sickness is the inclusion of an external motion tracking camera. This is placed in front of the user, at a distance of a metre or so. While the DK1 tracked the user's head rotation over three axis — yaw, pitch and roll — the DK2 also tracks the position of the user via the external camera. This means that not only can the user look around by moving their head, they can also lean into and away from the screen, as well as from side to side, and the in-game view will mirror the movement.

This is a mockup of the Virtuix Omni, a large harness used to capture the player's leg movements, allowing them to walk through their virtual worlds.

A rendered mockup of the Sixense STEM hand controller. The removable brick at the rear is the motion tracker, and up to five can be used simultaneously.

The original Rift DK1 used a slightly larger, but lower resolution, screen than the DK2, which is why it looks a little bigger from the outside.

Sony's Morpheus prototype offers a better headset design, but the interior specs aren't quite as impressive as the DK2, as it lacks low persistence technology.

It makes a huge difference in immersing the player in the world, now referred to as "presence". The screen also includes a special low persistence mode; the original suffered from motion blur when the user turned their head, making it impossible to read text while moving. The low-persistence mode clears this up entirely, keeping the view crisp and clear during any movement.

We tested the DK2 across several games and demos, and noticed immediately that games specifically built for the Rift offer a much more immersive experience. The space simulator *Elite: Dangerous* is one of the first Rift-enabled games on the market, but we found it very hard to see far-off enemies due to the low resolution of the screen. *Project Cars* suffered from a strange disconnect between our head movements and the in-game camera, but this is due to be fixed in an upcoming patch. Being able to look around the cockpit of the racing car was incredible though, and the resolution was just high enough to be able to spot upcoming corners with plenty of time.

There are currently around 50 custom-built Rift demos available for free from the Rift web site, and these provided easily the best VR experiences. Whether it was exploring the inky depths of the ocean in the *Deep Sea Dive* demo, or exploring a virtual recreation of the Millennium Falcon, the experience was incredibly impressive. It's hard to put into words just how real these demos feel, but once you've experienced it, going back to a 2D screen feels like you're looking at the game world through a small window. Perhaps the most impressive feat about the Rift DK2 is how light it is. Weighing a mere 440 grams, it's much lighter than the archaic headsets of the 1990s, and we didn't notice any neck-strain or motion sickness even after several hours of wearing the headset.

2015 — THE YEAR OF VR?

2015 seems to be the year that VR will finally make good on its promise, as both Sony and Oculus have mentioned that this is the year of release for their competing VR products. Sony's Morpheus has nearly identical specifications to the DK2, but its reliance upon the PS4 could be a major issue; VR requires extremely powerful hardware to deliver a stereo view at 75fps. As a result, we're betting our money on the product that Facebook is backing, the Oculus Rift. After testing the DK2 we're convinced that VR is going to revolutionise the way we play games and watch films, but it's going to be a long and interesting journey. 2015 will be the first small steps into these virtual worlds, and we can't wait to see where the journey takes us. ■

Get in the game

A head mounted display is only one part of the VR equation.

There's also the issue of player input. In the perfect virtual reality world, the player's body movements would also be captured and recreated in the game world, but creating the technology to do this is very complex.

Microsoft's Kinect 2.0 sensor seems like an obvious choice, but its high latency makes it unsuitable for VR, where low latency is key to immersion.

The Virtuix Omni (pictured far left) promises to allow players to walk around in their virtual worlds. This large device uses special shoes and a low-friction surface to allow the player to walk on the spot, while a harness stops them from falling over. The prototype currently uses a Kinect sensor to capture movement, but the consumer version will replace this with much more accurate accelerometers in the shoes. This should allow the device to capture the player turning, crouching, jumping and sprinting.

While the Omni takes care of the player's bottom half, there's still the issue of capturing what a player's hands and arms are doing. Sony has this covered already, thanks to the Playstation Move wands from the PS3, which also work with the PS4. Sixense is building a rival product called the STEM system, which uses special hand controllers to track the player's hands. Optional extra trackers can be installed on the user's arms, torso and legs, to fully capture the player's body position.

Aimed at PC gamers, a recent demo of the unit showed it controlling a virtual light saber with impressive accuracy. Priced at US$580 for the full five-sensor kit, the STEM is currently only available for pre-order.

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Ultimate budget gaming PCs

Dave James picks a peck of pickled components and throws them into two $600 rigs to see how much harm he can do to the console industry.

When the current generation of consoles was first announced, it was with some pleasure that we discovered they were essentially just low-power PCs in diminutive boxes. Haha, those poor fools buying cheap gaming rigs to play the latest AAA games at smooth frame rates... And right there was the problem for us normal PC folk. While the new consoles were at their hearts simply PCs, they were the sort of bargain-priced gaming rigs we'd struggle to piece together ourselves without the subsidised might of either Sony or Microsoft.

Building a PC capable of throwing the latest games around at the full 1080p resolution of your telly box for less than the $600-odd you'd spend on a new console seemed beyond the realms of home-build possibility, but recent PC advances have made it a reality. We always knew PC power would reach the right price point to eventually best the consoles – we just didn't think it would be this soon.

The first bit of hardware that started the ball rolling was the release of the desktop version of AMD's Kabini platform. Both the Xbox One and PlayStation 4 run modified eight-core versions of the Kabini chip, and while the commercially available version is restricted to just four Jaguar cores, it's still a great value motherboard/CPU combination and allows for connections to proper PCIe-based graphics cards. Those weak CPU cores limit the speed of high-end discrete GPUs, but surely some enterprising GPU manufacturer would come up with a decent, low-power, low-cost graphics card to ably partner it, wouldn't they?

Then, like some green knight-errant, Nvidia rode over the horizon with its impressive first Maxwell-powered graphics card. The GTX 750 Ti had a rather understated launch; it was the first time a new GPU architecture had been released at the budget end and under the same naming scheme as the previous generation. It was very well received, though – a bargain-priced GPU that could be powered entirely from the PCIe slot itself and still offer competitive performance at the highest settings at 1080p.

> "We knew PC power would eventually reach the right price to beat consoles."

There it is then: the base for a quality budget gaming rig. AMD and Nvidia living together in harmony in my motherboard. But that's not the whole story. Not generally interested in budget PC gaming, Intel has just done the unthinkable: it's released a budget unlocked dual-core Haswell processor. That means we've got options, so lets see what we can put together for the same price as the latest consoles.

Thermaltake

Choices, choices

Selecting the perfect options for a perfectly-affordable gaming machine.

CPU

AMD Athlon 5350

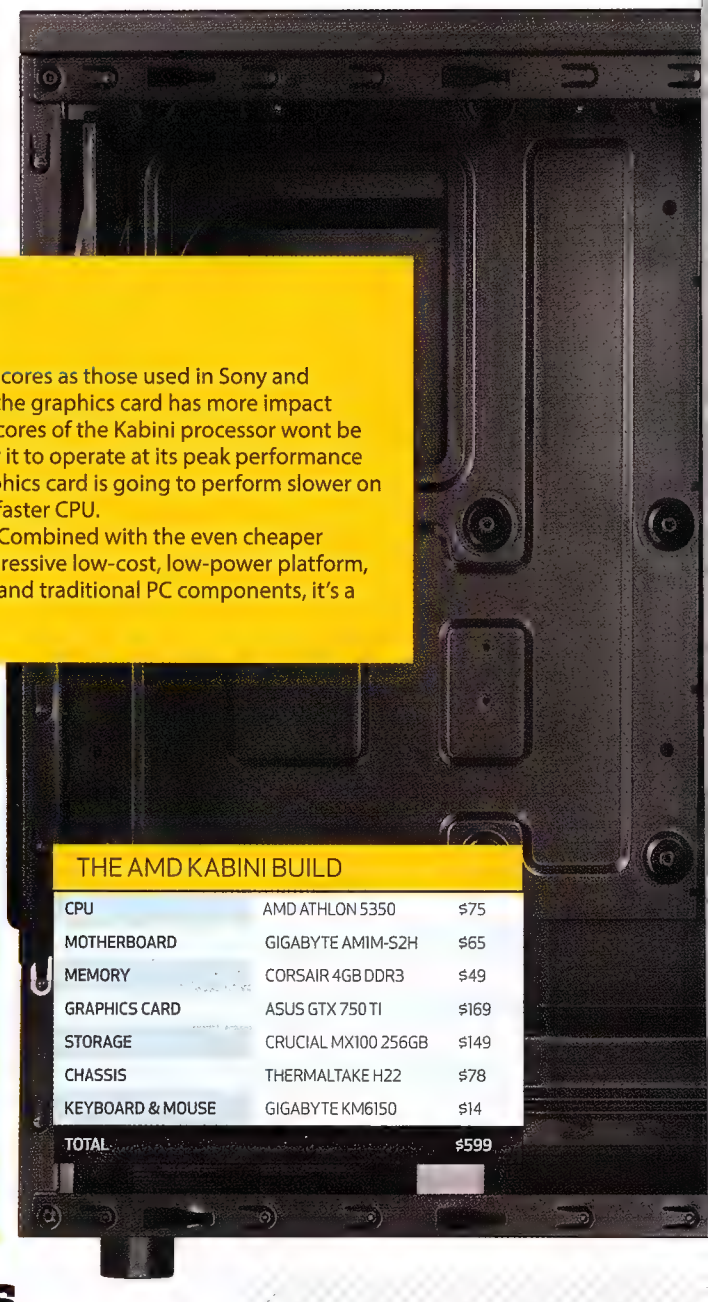
The desktop Kabini chip has half as many cores as those used in Sony and Microsoft's consoles, but in a gaming PC the graphics card has more impact on in-game performance. The weak CPU cores of the Kabini processor wont be able to feed the GPU data fast enough for it to operate at its peak performance though, which means that any given graphics card is going to perform slower on the 2GHz Athlon 5350 than it would on a faster CPU.

The key here is its incredibly low price. Combined with the even cheaper motherboard Kabini makes for a very impressive low-cost, low-power platform, and with support for PCIe graphics cards and traditional PC components, it's a decent basis for a cheap PC.

Motherboard

Gigabyte AM1M-S2H

At a little over 60 bucks, we challenge you to find another PC motherboard that provides this level of component support for so little cash. Obviously there are compromises to be made in a board so inexpensive, but that's only to be expected in such a low-level platform as the AM1 AMD chipset used for Kabini. Although you get both USB 3.0 and SATA 6Gbps support, the PCI Express connection is only a PCIe 2.0 interconnect and only a x4 bandwidth despite being a full x16 slot. It's a neat little board to house the Athlon 5350 and lets you get the most out of a low-end setup.



THE AMD KABINI BUILD

CPU	AMD ATHLON 5350	$75
MOTHERBOARD	GIGABYTE AM1M-S2H	$65
MEMORY	CORSAIR 4GB DDR3	$49
GRAPHICS CARD	ASUS GTX 750 TI	$169
STORAGE	CRUCIAL MX100 256GB	$149
CHASSIS	THERMALTAKE H22	$78
KEYBOARD & MOUSE	GIGABYTE KM6150	$14
TOTAL		$599

Common components

The parts shared by both these budget PC builds.

Graphics card

ASUS GTX750TI-PH-2GD5

One of the best things about Nvidia's Maxwell architecture is that it doesn't need external PCIe power connectors. There's also the way the GPU runs so chilled during use. The entry-level Maxwell card is the GeForce GTX 750 Ti, of which there's really no shortage on the market. ASUS's isn't quite the cheapest you'll find, but it's only around $15 to $20 more than that, so in our mind it's worth forking out a little more for the premium branding.

It's a mildly-overclocked card, and it's able to offer impressive gaming frame rates in most modern titles running at 1080p. Of course if you try pushing the resolution any higher you'll start to hit problems, but at the standard HD res most games will run happily at close to their top settings.

Chassis, keyboard & mouse

Thermaltake Versa H22

For $78, this case combo includes a reasonably-classy black chassis plus a pre-installed Thermaltake 500W power supply. (For those who're after something a little more 'gamer' themed, check out the similar Versa H21 and H23 cases — they're largely the same, but with edgier-looking front panels.) The low-power components we're filling this machine with mean you don't need a huge PSU, but 500W will allow you to upgrade the graphics card to one which needs an extra

THE INTEL ANNIVERSARY BUILD

CPU	INTEL PENTIUM ANNIVERSARY G3258	$79
MOTHERBOARD	GIGABYTE B85M-D2V	$75
MEMORY	CORSAIR 4GB DDR3	$49
GRAPHICS CARD	ASUS GTX 750 TI	$169
STORAGE	CRUCIAL MX100 256GB	$149
CHASSIS	THERMALTAKE H22	$78
KEYBOARD & MOUSE	GIGABYTE KM6150	$14
TOTAL		$613

six-pin PCIe power connection. You don't get modular PSU cabling at this price, so you won't get the prettiest of PC innards.

The case itself is functional and nothing more. There are three 3.5-inch HDD slots, three 2.5-inch bays and it will support either micro or full-sized ATX boards.

For a keyboard and mouse, we'd suggest grabbing the basic-yet-functional Gigabyte KM6150 for $14 on the street.

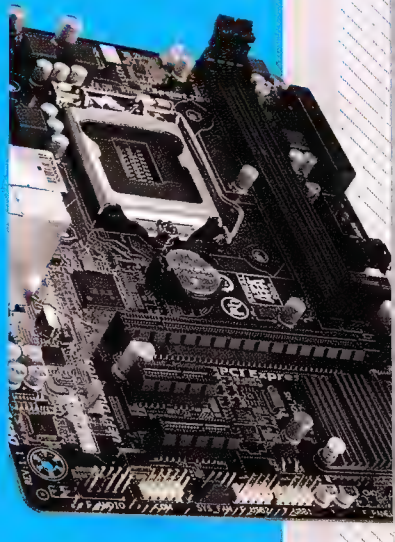
CPU

Intel Pentium Anniversary G3258

This is a bona fide dual-core 22nm Haswell processor running at a decent 3.2GHz base clockspeed out of the box. And because it's only running a pair of Intel's latest CPU cores, it doesn't run that hot either — for once, that Intel stock cooler won't be out of its depth sat inside your PC. The real beauty of the Pentium Anniversary chip is that because most current game engines really only want one fast core you're not really missing out on gaming performance compared with a CPU three times its price. Only *BF4* at the moment makes a noticeable difference between this and a Core i5 quad-core.

Motherboard

Gigabyte B85M-D2V



There's little point in pairing the $79 Pentium Anniversary chip with a massively expensive motherboard, so this bargain B85 board makes a great companion for Intel's new CPU. Unlike the AM1 board, the B85M-D2V has a full-length, full-bandwidth PCIe 3.0 slot for the graphics card as well as more SATA and USB connections too. The big bonus about this Gigabyte board though is its overclocking performance. Now, officially speaking the B85 chipset doesn't support CPU overclocking, but most board manufacturers have relaxed the limits on which chipsets can overclock and the latest update to the B85M-D2V will happily push the Pentium Anniversary chip well over 4GHz with the stock cooler. The only caveat is that Intel could throw away all that goodwill if it shuts down OC support for anything that isn't a Z-series chipset, but we think that's unlikely for now.

Solid state drive

Crucial MX100 256GB

We'll be honest, we really do struggle using PCs without SSDs at their hearts. Yes, we're storage snobs, but the difference between spinning platters and NAND flash storage is like the difference between chalk and the ephemeral notion of shame.

Crucial has been taking to the storage world like a disgruntled despot recently, slashing prices all over to starve the rest of its denizens. Its latest drive of mass destruction is the MX100 and, while it can't boast the performance of Samsung's 840 EVO, it's the cheapest 256GB SSD around.

That's half the storage of the latest consoles, but it's 256GB of solid state storage vs 500GB of spinning platter sloth. Windows will only take up 30GB, leaving you a fair amount of room for games. And hell, if you need more space, $60 will buy you a 1TB hard drive for all your storage needs.

Technical analysis

Getting the grunt.

When we first set out to put together this console-beating budget PC we were looking squarely at the desktop Kabini/GTX 750 Ti combo to offer decent 1080p gaming performance, as well as the capability to be used like a standard desktop PC. Then Intel dropped the Pentium Anniversary bomb. The extra $14 that you'll spend on the Intel CPU/motherboard combo will net you a far better machine than the cheaper – but weaker – Kabini platform can offer.

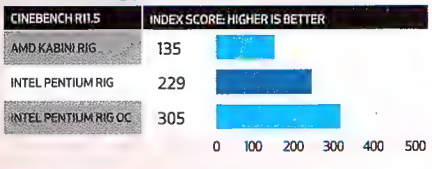
We've carried out a host of graphics, gaming and platform tests with the two different setups and the Intel one comes out on top across the board, especially when you factor in the incredible overclocking performance you can squeeze out of the G3258 with the B85 motherboard we've been using.

All of our gaming and graphics tests were carried out at the highest possible 1080p settings using 4x anti-aliasing as standard. Read on to see the benchmark results.

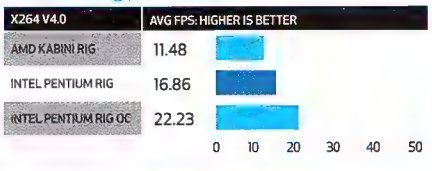
> "The extra $14 that you'll spend on the Intel CPU/motherboard combo will net you a far better machine than the cheaper — but weaker — Kabini platform can offer."

CPU PERFORMANCE

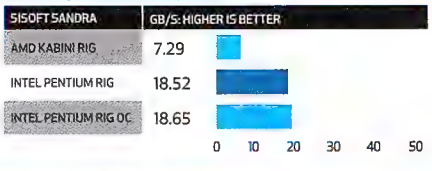
CPU rendering performance



CPU encoding performance

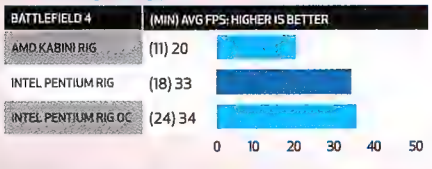


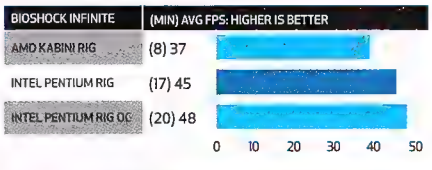
Memory bandwidth performance

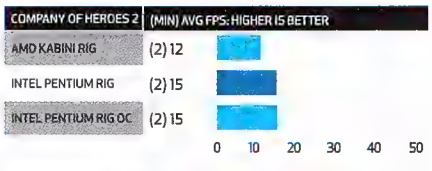


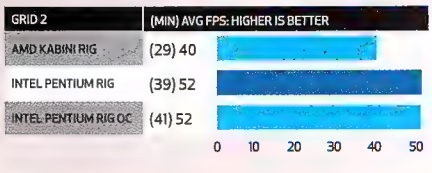
GAMING PERFORMANCE

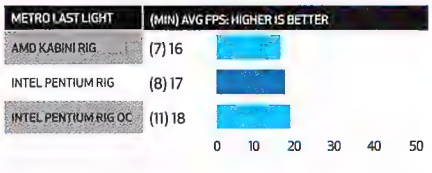
DirectX 11 gaming performance (1080p)

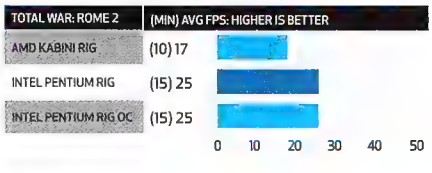












"We knew the CPU would struggle with DICE's processor-intensive game engine, but we weren't prepared for how little extra performance we could squeeze out of the setup at the lower levels."

And the winner is...

THE INTEL ANNIVERSARY BUILD

Quite simply this has to go down as a clear victory for the Intel/Nvidia partnership, yet again. But were it not for the sudden appearance of the Pentium Anniversary CPU, none of that would have been possible. The Kabini platform was the first to make us think that we might be at a stage where we could put together a full PC that could compete with the latest consoles in performance and best them in functionality for the same price. And it does a pretty good job, but the compromises you make in opting for that platform end up being relatively extreme.

The weak CPU cores mean the GTX 750 Ti is left doing all the heavy lifting and without adequate CPU backup it struggles to get up to playable frame rates. The key for us was the *Battlefield 4* tests. We knew the CPU would struggle with DICE's processor-intensive game engine, but we weren't prepared for how little extra performance we could squeeze out of the setup at the lower levels.

Across the board the extra single-threaded performance of the Haswell cores at the heart of the Pentium Anniversary CPU made a huge amount of difference in the gaming benchmarks and the system tests. As well as pushing up the average frame rate by a considerable amount, the rise in the minimum frame rate is just as significant. Being able to offer a smoother performance is realistically more important for a gaming PC than just a higher average frame rate.

You may look at the benchmarks opposite and not think much of the gaming performance of these budget setups. But don't forget those benchmarks have been run at the highest, system-punishing 1080p settings, just as we do with every other machine we test in *APC* Labs. Toning the extreme high-end game settings down a notch on the Intel machine will net you gaming frame rates that will plaster a big grin all over your mush.

Interestingly, the extra overclocking performance of the Pentium G3258 processor makes relatively little difference between the highest and stock clockspeeds. Our full CPU review had the chip paired with the GTX 780 Ti and, while the dual-core chip is a mismatch with such a high-performance card at its base clock, it's a much more natural pairing with the GTX 750 Ti. We've said it before: balance is everything when you're building a gaming PC.

And that Palit GTX 750 Ti deserves a mention too. It's the first such card to arrive with a fully passive GPU cooler attached to it, and, along with the Gigabyte GZ-MA02 chassis, makes for an almost silent PC. You'll barely know this thing is running apart from the gaming joy on your screen.

Although we have created a full gaming PC for around $600, including a hefty 256GB SSD, we haven't included an OS in that price. Slapping another $100 on the build for a Windows 8.1 disk pushes the price up of the Intel machine up to $700. But with the rise of Linux as a viable gaming platform, a free OS such as Mint will get you a versatile, bargain-priced Steam machine without the licensing fee. ■

how to

» QUICK TIPS

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APC and its readers can be one giant helpdesk. If you have a technical problem, chances are one of us can solve it.

WINDOWS

REALTEK KILLED MY SOUND

I have an ASUS P5KPL-AM SE motherboard and I use the onboard audio output for my sound. It used to work perfectly, but once I installed the Realtek drivers, the sound level dropped immensely. Everything is pushed up to 100% but the sound level is extremely low. I can barely hear what is being played. I'm using Windows 7 Home Premium (64-bit) and previously used the automatically installed drivers, so I uninstalled the Realtek drivers and reverted back to the old drivers, but it didn't solve the issue.
Bretton Tree

There are two possibilities. The first is that you only think you have uninstalled the drivers, and whichever Realtek DLL was causing problems with the integrated audio on your motherboard is still there. You could try rolling back, if you have a system restore point, or you could wipe and reinstall Windows 7.

The second possibility is that this is not a driver problem at all and it just happened at the same time. Are you using USB speakers? Is the faint sound definitely coming from them? Or is there something plugged into the headphone jack as well? I suppose it's also possible that Windows thinks you have a 5.1 surround sound system and is only outputting some of the channels to your speakers. Have a look at the 'Hardware and Sound' section of Control Panel and make sure that the speaker configuration there matches what you actually have.
Luis Villazon

HARDWARE

WIRELESS PRINTER NOT WIRELESS

I'm having a problem connecting to my wireless Canon Pixma MG3150 printer via my Windows 8.1 laptop. It prints fine via USB, but not from the wireless connection.
Simon Gaines

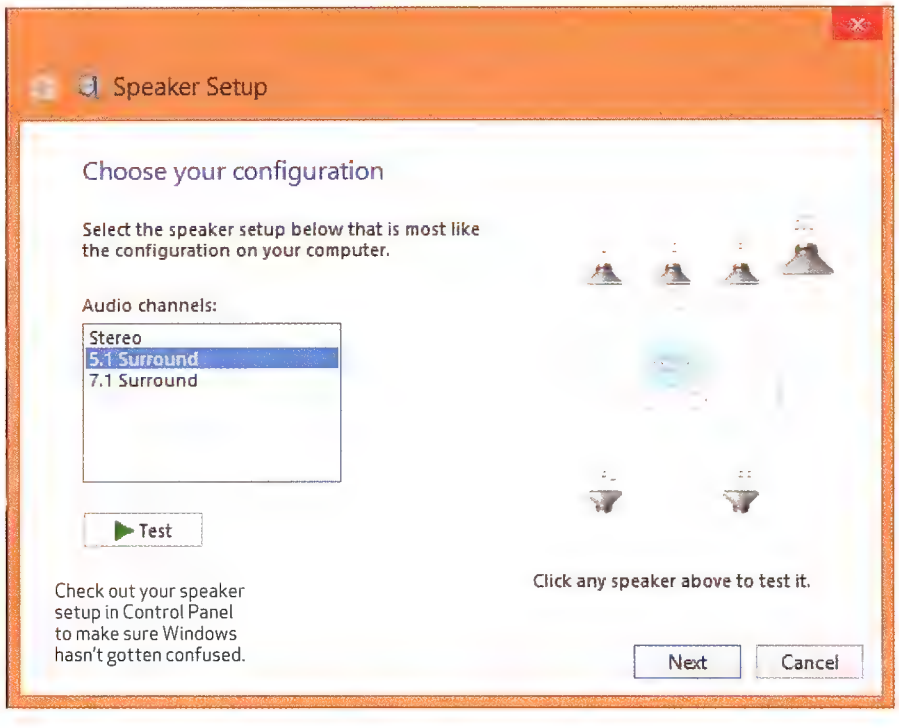
It sounds to us as though the printer driver was installed when the printer was physically connected to your laptop via a USB cable. To fix this problem, begin by verifying that the wireless printer has been configured to connect to your wireless network using its on-board controls. Next, open 'Devices and Printers', locate the printer in the list, then right-click it and select 'Remove device' to delete it. Now, with the printer connected wirelessly to the network (and not plugged into your PC via USB), click 'Add a printer'. Windows will scan for available printers – it should eventually detect the printer over the network, allowing you to select it and then set it up to work wirelessly in future.
Adam Ifans

WINDOWS

GPU DRIVER WOES

I have an issue with my HP Pavilion DV6. The graphics card I have is an AMD Radeon HD 6400M Series and I'm running Windows 7 64-bit. I have AMD Catalyst version 13.6 Mobility Beta 2. I'm aware that my drivers are out of date. I have Catalyst 13-12, and when I try to install it, it says Catalyst Control Center and my display driver are up to date, when they clearly aren't. It ends up just installing the Catalyst Install Manager and the AMD app. It's the same thing with 13-9, 13.11 beta 9.2 and 14.1 beta 1.6. Is there a way I can update my Catalyst Control Center or do I have to buy a new computer?
Dumi Vera

Buying a whole new computer is probably overkill. All you actually need to do is uninstall Catalyst, but you have to make sure you do it thoroughly. You probably have fragments of a dozen different versions scattered across your Windows folder by now. There is a thing called the AMD Clean Uninstall Utility, which on the face of it sounds as if it would do the job, so let's start with that. You can download it from **tinyurl.com/m3655pm**. Run it, reboot and then run it again to be sure. Then try downloading the latest version of Catalyst (which


Speaker Setup
Choose your configuration
Select the speaker setup below that is most like the configuration on your computer.
Audio channels:
Stereo
5.1 Surround
7.1 Surround
Test
Click any speaker above to test it.
Check out your speaker setup in Control Panel to make sure Windows hasn't gotten confused.
Next
Cancel

Don't set up your printer via USB if you just want to print wirelessly.

Often, the only course of action for a failed hard drive is to replace it.

may well have been updated by the time you read this). If that still doesn't install correctly, you can reinstall Windows, but I doubt it will come to that.
Luis Villazon

LINUX
NETWORK MANAGERS

I recently reformatted my hard disk and installed Linux Mint 16 by burning the .iso image to DVD, as I've done once or twice before. This time, when I load Wicd from the package manager, I get a window saying 'Wicd needs to connect to your network card'. I click this and it then says 'could not connect to Wicd's D-Bus check WICD log file for error messages'. I could run this program with no problems before this last install.
John Jackson

There are two parts to Wicd. The daemon runs in the background as a root process, which is generally started by your service manager when the computer boots. The client runs on your desktop and provides you with the interface to control the Wicd daemon. The two parts use D-Bus to communicate. The error message you see means that either the D-Bus service is not running, which is unlikely as you'd then be seeing other issues too, or the Wicd daemon is not running. First, install the Wicd package and it will install the daemon and clients. Next, try running Wicd from a terminal, which will probably give an error message that ends with: os.symlink(dest, backup_location) OSError: [Errno 17] File exists.

If you see this, the problem is that the Wicd daemon is failing to start, because of an incorrect symlink. Look at:

```
ls -l /var/lib/wicd/resolv.conf.orig
```

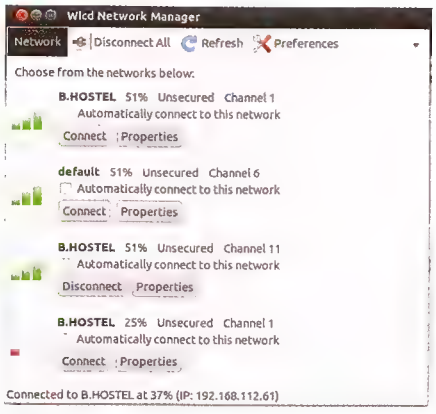
and you will see red highlighting that denotes a broken symbolic link. Fix the link with this command:

```
ls -sf /run/resolvconf/resolv.conf /var/lib/wicd/resolv.conf.orig
```

Now Wicd should start from a terminal with:

```
sudo wicd start
```

This will appear to do nothing, which is good – it means the service has correctly started in the background. Mint uses NetworkManager by default, so you will need to disable this in the Startup Applications section of the Mint Control Centre – it appears as just Network. Once you have done that, and ensured that Wicd is set to start in the Services section of the Control Centre, you can reboot. Now the Wicd client should start with no errors and will show its icon in the system tray.



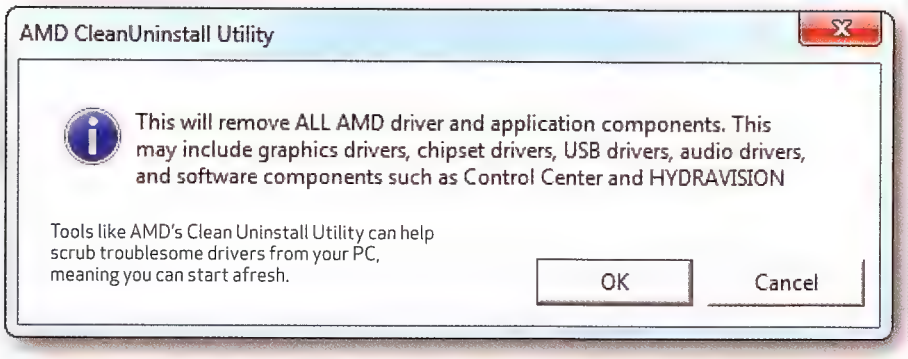
Wicd is one of the most popular network connection managers for Linux.

HARDWARE
START UP SHUT DOWN

I'm having trouble starting up my Acer laptop. One night it had some Windows updates it needed to finish installing. After it had restarted, it asked me for a disk drive checkup or maintenance check, but I decided to skip it 'cause I was impatient. Then the following morning it showed me the Acer logo (as usual when it starts up), then it showed the command line for a split second and then my laptop shut down. Then it started up and did the same thing and shut down. It doesn't even show me Windows startup or Windows BIOS, or startup command, nothing.
Timothy Rose

The maintenance check you were impatient about is triggered when Windows doesn't shut down correctly. On a normal shut down, the last thing Windows does is write a line in a log file to confirm that Elvis has left the building. When Windows next starts, it looks for this line and if it isn't there, it assumes that somebody yanked a power cable out during the previous session. This can corrupt files and folders on the hard disk if there were buffered writes pending at the time, so it prompts you to run Scandisk.

Since you don't mention anything about an unexpectedly abrupt shutdown, it follows that something else must have stopped the Elvis message from being written. The most likely culprit is a failing hard disk, which is consistent with the other symptoms that you have been experiencing. Replacing the hard disk isn't trivial on a laptop, but it's perfectly doable.
Luis Villazon


AMD CleanUninstall Utility
This will remove ALL AMD driver and application components. This may include graphics drivers, chipset drivers, USB drivers, audio drivers, and software components such as Control Center and HYDRAVISION
Tools like AMD's Clean Uninstall Utility can help scrub troublesome drivers from your PC, meaning you can start afresh.
OK
Cancel

Stream Steam games to a remote locale

Henry Winchester helps you play the latest games remotely or on low-end hardware. Handy..

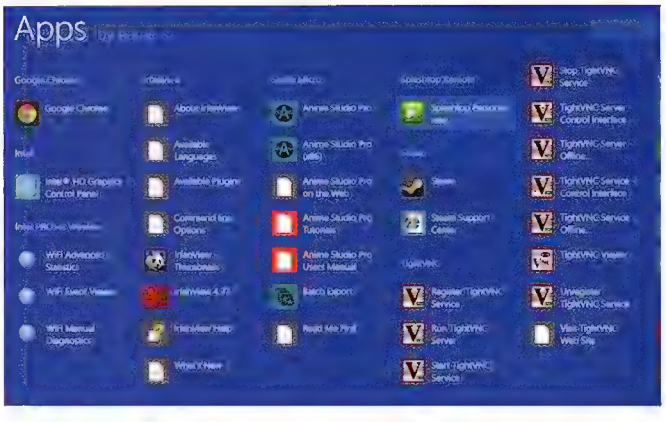
One of the Steam OS's most promising features is its ability to stream games hither and thither, so in a pretend version of the future you'll be able to play *Half-Life 3* on a Commodore 64. Maybe.

However, you don't need to sit around waiting for Valve to put the finishing touches to its revolutionary Linux operating system to be able to experience big games on little screens because Splashtop already does a damn good job of it.

The software is essentially Windows Remote Desktop on steroids, so it's easy to use and, yes, it can stream 3D games in decent quality at playable frame rates, provided that you have a respectable internet connection. We'll also show you how to play from afar by using Splashtop in conjunction with Hamachi's virtual private network (VPN) software.

Step-by-step: Swim upstream

Access your computer remotely and play games online.

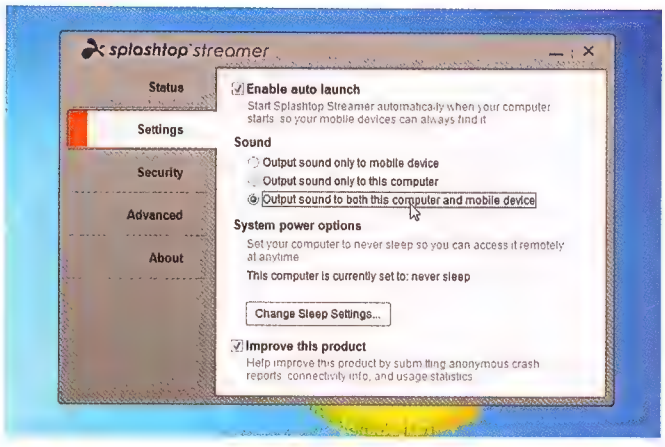


1 IN WITH A SPLASH

To get started you'll need a couple of computers up and running on to the same network. Either of these can be a Mac, but because this is *APC* we'll scoff at you for owning such a thing. For the purposes of this tutorial we'll refer to the source computer as 'Mother' and the target computer as 'Norman'.

2 SPLASH GORDON

On Mother, visit **www.splashtop.com**. You'll want the Personal version, so find it on the site, download the Streamer to the computer and fire it up. Go to Norman and download the Windows app; there's one version of the software for Windows 8 — which is a Metro App — and another one for the good editions.

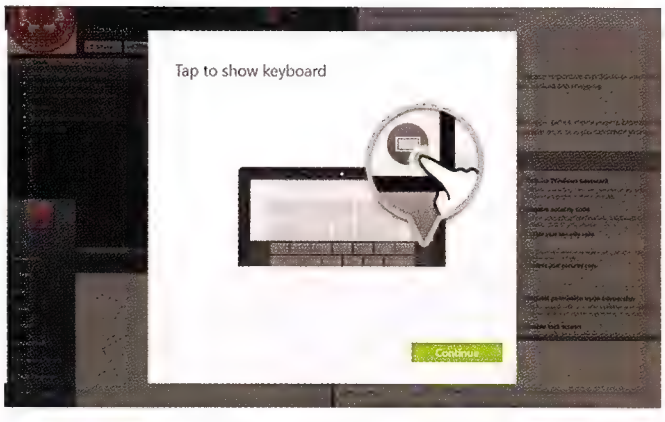

splashtop streamer
Status
Settings
Security
Advanced
About
Enable auto launch
Start Splashtop Streamer automatically when your computer starts so your mobile devices can always find it
Sound
Output sound only to mobile device
Output sound only to this computer
Output sound to both this computer and mobile device
System power options
Set your computer to never sleep so you can access it remotely at anytime
This computer is currently set to: never sleep
Change Sleep Settings...
Improve this product
Help improve this product by submitting anonymous crash reports, connectivity info, and usage statistics

3 THE SPLASH STREET KIDS

Once you've set up the Splashtop App on Norman, fire it up and create an account. Go to Mother, open Splashtop Streamer and enter the same account details. At this point, tweak your settings. By default, Splashtop streams sounds coming out of Mother to Norman. You may want to change the outputs if you intend to use it in a quiet place.

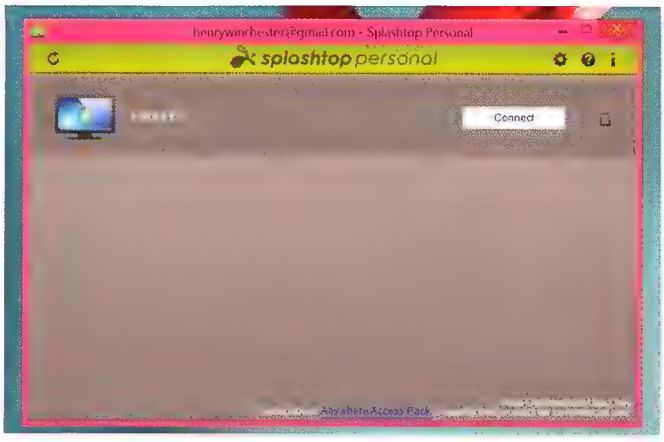
5 SPLASHING OUT

Click on the relevant computer to connect to it and you'll be fully in charge of the desktop, remotely. You'll find a few quick settings if you swipe up in Windows 8, or use the downwards-facing arrow in other Windows versions. You can choose between low-quality and high-quality streaming — the former is better for lag-free gaming.



7 CRASHTOP

The good ol' Windows recovery of pressing Ctrl-Alt-Del will cause the computer itself to go to the Task Manager. Splashtop includes an on-screen Ctrl-Alt-Del function, which is handy if a game starts playing up on Mother. On the Windows 8 version there's an option to access the on-screen keyboard and cursor keys.



4 SPLASH TEST DUMMIES

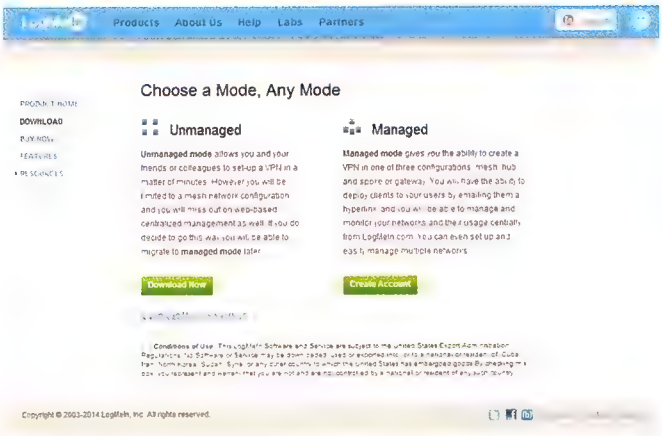
You'll find the option to change Mother's sleep settings here — the last thing you want is her nodding off when you're involved in a game. Return to Norman and the Splashtop App, and it'll automatically find Mother. The Windows 8 App works differently to the one for other Windows versions, but both contain similar functionality.

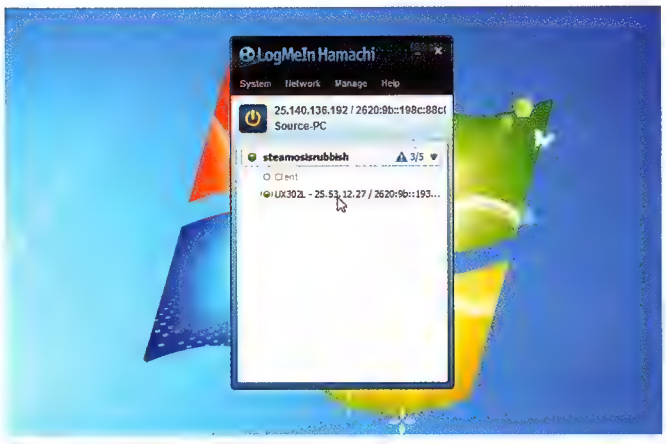
6 SPLASHBACK

Test out some games with Splashtop before you venture into the big wide world. We had varying results — *Dota 2* and *Dishonored* had no problems, but *Batman: Arkham Origins* and *Counter-Strike: Global Offensive* gave us errors. There's a pretty simple solution: just make them run in windowed mode (usually Alt-F12) on Mother.

8 SPLASH OF THE TITANS

Splashtop's personal version is limited to run on local area networks. This is great for playing games in the living room, but rubbish if you want to indulge in *Titanfall* while you're in a lecture. You can upgrade your account for internet Splashtopping for $1.99 a month, but there is a workaround in the shapely form of Hamachi.



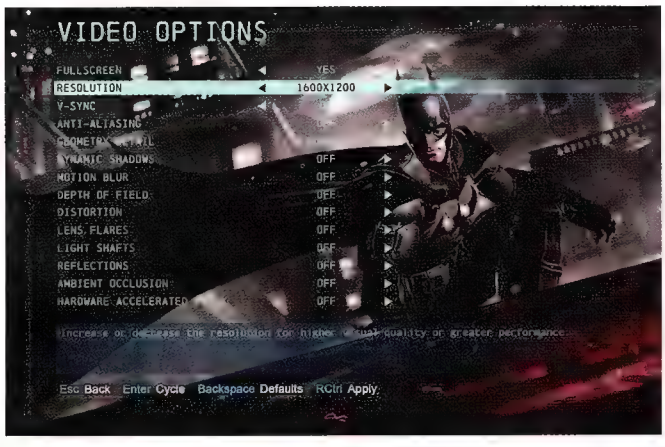


9 WHIP-SPLASH

Run the following steps on a local area network first. Visit **secure.logmein.com/products/hamachi/download.aspx** on both Mother and Norman. Download and install the 'unmanaged' software on both machines. On Mother, run the software, enter names for both PCs, and choose 'Create a new network'. Enter a network ID and a password.

10 JOIN SPLASHANU

Now run the software on Norman, but choose 'Join an existing network.' Find the network you set up and enter the password if necessary. Congratulations — you've created an internet wormhole! The next step is to try it out with an internet connection. Go to your local library and run Hamachi on their network, then run Splashtop.

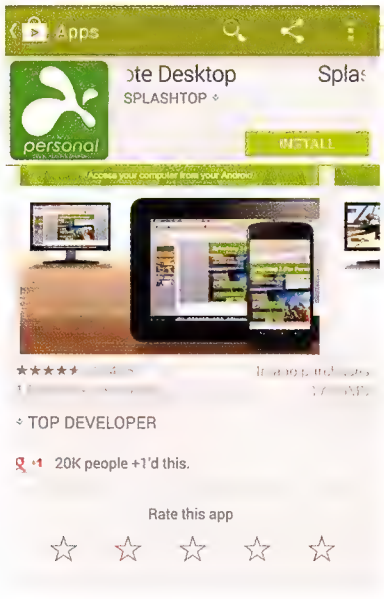


11 COMMANDER DATA

Splashtop will eat rather a lot of data and requires a reasonably fast connection. Dial it down using the quality option if it's struggling, or if you're using it on a mobile network. You can fiddle with Mother's desktop and in-game resolution remotely if you are experiencing stuttering or lag. This also helps if she's struggling to keep up.

12 SAY HAMACHIS

As well as letting you access your PC via Splashtop, Hamachi can be used to configure a virtual local area network. Get your friends to download the software, then give them the login details from step nine. Once they're connected, you'll have your own virtual network so you can host and play games with your friends and no one else.



13 SECURITY: FIRM

Hamachi gives you a secure connection to your home computer, which is reassuring if you're completely paranoid and using a computer in a public place. You can also access shared folders via Windows network, so you can play any films and music stored on your home PC via the internet without using Splashtop.

14 SPLASH FOR QUESTIONS

Now that you've got Splashtop set up on your Mother, you can access her from any Norman you own, and when you're not playing games, you can watch videos and listen to music. Both Splashtop and Hamachi also come with iOS and Android apps, so you can experience the Holy Grail of full, proper games on touchscreen devices. Although Hamachi's mobile app is currently in beta, it does the job splendidly. ■

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Control Excel filters with macros

Helen Bradley explains how to control filtering data on a worksheet using macros.

While the filter features in Microsoft Excel are useful for experienced users, if your users are less experienced, then they can be a little cumbersome to work with. If you know in advance the type of data that you'll be querying and the queries you want to make then you can use Excel macros to filter worksheet data as we'll show you.

THE SCENARIO

To create the solution you will need some data. Ours is stored in the range A2 to F20 – you can see it in the images below. Each macro will be run from a button added to the worksheet. To set these up you will need to first create the code then add and configure the required buttons.

To create the code, from the Developer tab click Visual Basic Editor and then select the workbook in the Project pane. Choose 'Insert › Module' and type this code:

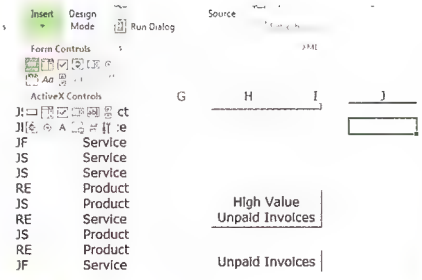
```
  Sub Reset_Filter()
  If Not (ActiveSheet.
AutoFilterMode) Then
      'if the filter is not on,
turn it on
      ActiveSheet.
Range("A2:E20").AutoFilter
  ElseIf ActiveSheet.FilterMode
Then
      'it is on so reset it and
show all rows
      ActiveSheet.ShowAllData
  End If
  End Sub

  Sub Show_Unpaid_Invoices()
      Reset_Filter
      Selection.AutoFilter
Field:=4, Criteria1:="<>Pd"
  End Sub

  Sub HighValue_Unpaid_
Invoices()
      'assume high value is >=
$10K
      Reset_Filter
      Selection.AutoFilter
Field:=3, Criteria1:=">=10000"
      'the following searches
for an empty field
      Selection.AutoFilter
Field:=4, Criteria1:="="
  End Sub

  Sub Unpaid_RE_or_JS_
invoices()
      'this is an OR filter..
      Reset_Filter
      Selection.AutoFilter
Field:=5, Criteria1:="RE",
Operator:=xlOr, Criteria2:="JS"
      Selection.AutoFilter
Field:=4, Criteria1:="="
  End Sub

  Sub All_RE_or_JS_or_JF_
invoices()
  Reset_Filter
  Selection.AutoFilter
Field:=5,
Criteria1:=Array("RE", "JS",
"JF"), Operator:=xlFilterValues
  End Sub
```

These macros show how to set up and clear a filter on a worksheet as well as how to filter data in different ways. For each filter the Field is the column number within the data area – these are numbered starting at 1. Each criteria you are matching is placed inside a set of double quotes. To search for an empty field – such as when searching for unpaid invoices – search for "=". To filter on more than two items at a time from a single field you will need to create an array of items as shown in the last macro.

These examples can be adapted to your own circumstances. ■

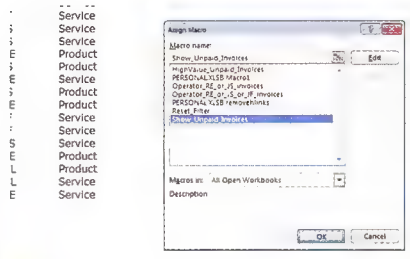
Get it

Download the Excel file you need for this article from: **www.apcmag.com/magstuff.htm.**



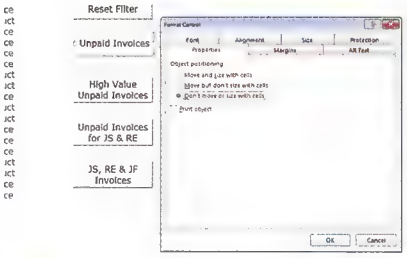
1 ADD BUTTONS

To add a button to a worksheet click the Developer tab, choose Insert and from the Form Controls list click Button (Form Control) and drag out a button. Right click the button and choose Edit Text to add text to explain the macro's purpose.



2 ASSIGN A MACRO

Right click the button, choose Assign Macro and assign the appropriate macro to the button.



3 LOCK THE POSITION

So that you can arrange buttons to the side of the data, right click each button in turn and choose 'Format Control > Properties' tab and select 'Don't move or resize with cells' to prevent the button moving when the data is filtered.

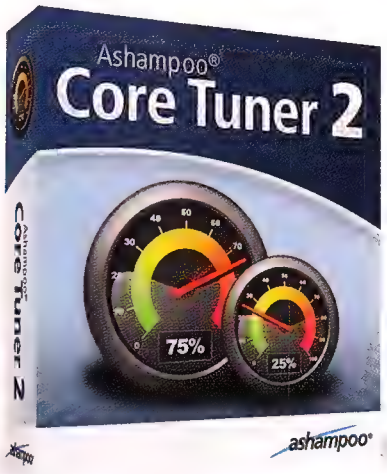
disc contents

» OUR SELECTION OF EXCLUSIVE FULL-VERSION PROGRAMS

ISSUE 407, OCTOBER 2014

Maximise your CPU

Tweak your processor performance with Ashampoo Core Tuner 2



FULL VERSION WORTH $19

When several processes are executed at the same time it is highly important for high-end computers as well as older PCs that the processor power is distributed and used efficiently, in order to ensure a smooth workflow. Ashampoo Core Tuner 2 enables you to use the complete power of your processor in the best possible way, while it hardly uses up any resources itself thanks to driver technology. The optimisation of single processes can take place fully automatically or manually. Furthermore, the new Live Tuner accelerates the start of new applications by instantly assigning all available resources, while the system is already working to full capacity.

Speed up your system

Optimise your PC with 1-abc.net Registry Washer 7

FULL VERSION WORTH $21

The Windows Registry is a place where all programs add important configuration data. When you start your PC, Windows always checks the Registry to let all installed software know local settings, program paths, last opened documents, specific user options and much more. Unfortunately, not every software program removes each entry it makes to this registration database when it's not necessary any more. With 1-abc.net Registry Washer 7, you can speed up your system by cleaning up your Windows Registry.

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FULL VERSION WORTH $14

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SYSTEM REQUIREMENTS

- A DVD-ROM reader or burner.
- The *APC* disc is designed for use with up-to-date browsers (for example, Internet Explorer, Chrome, Firefox).
- The interface included on the *APC* disc requires a JavaScript-enabled browser.
- An internet connection may be required for online registration of software before use.
- The software packages on the *APC* disc have different system requirements. Software is included on the disc for Windows XP, Vista, 7 and 8.

BEFORE INSTALLING

- Check the disc using a virus scanner complete with the latest antivirus data updates. The disc was checked before burning, but new viruses are being discovered all the time.
- Back up any important system and data files. It is not recommended that the software contained on these discs be installed on production machines.
- If you have any questions regarding the use of the *APC* disc, click the 'Help' button at the top of the screen.

USING THE DISC

- Insert the disc into a CD/DVD-ROM reader or burner and your web browser should automatically load the interface. If not, launch your web browser and load the default.html file from the root directory of the disc.

HELP

- If you have any problems with the *APC* disc, please visit **www.apcmag.com/disc.htm**.
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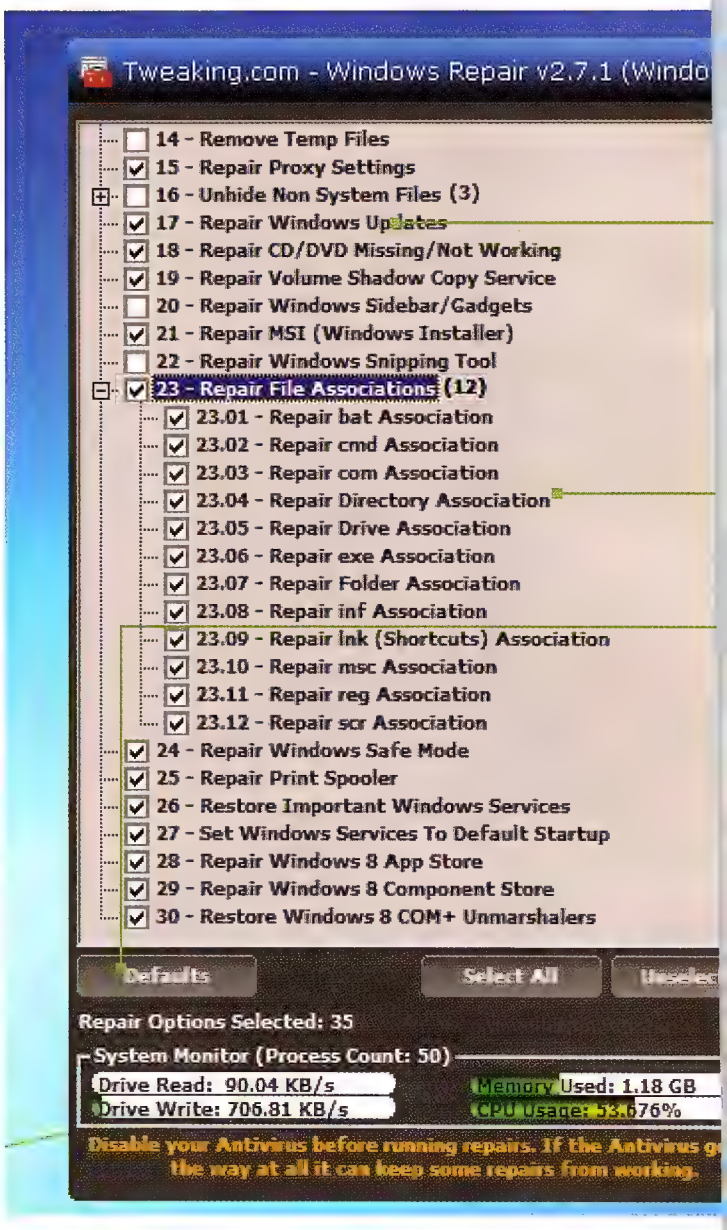
Fix PC problems with the Windows Repair tool

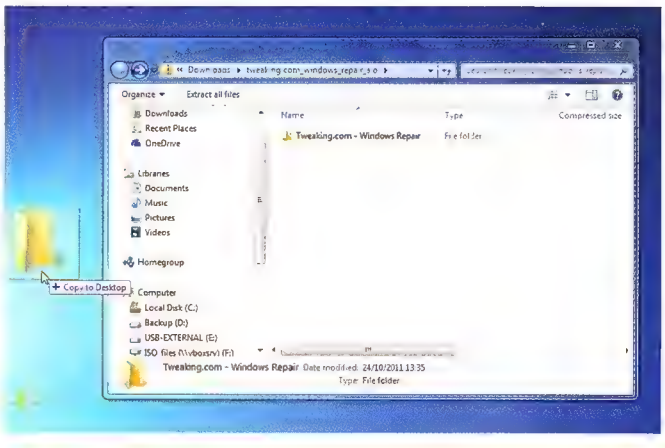
Is your OS acting up? Let the Windows Repair tool find and fix the problem, says Nick Peers.

Troubleshooting PC problems can be a real pain, particularly if you need to resolve the issue quickly and can't easily pinpoint a cause – and therefore solution – to your woes. Windows' built-in tools can go some way towards solving common issues, but if you're currently struggling to fix a problem that seems deeply embedded, then Tweaking.com's Windows Repair (All in One) utility could be a lifesaver. It performs a series of basic checks, takes key backups and then presents you with a list of repair tools that can fix all manner of issues.

It's worth running many of the tools in this package even if they don't appear to be linked to your problem, as sometimes your symptoms may point to a series of underlying glitches that aren't obviously linked. In this tutorial we'll take you through the program one step at a time, hopefully guiding you towards that elusive solution to your problem and saving you the effort of performing a full Windows reinstall.

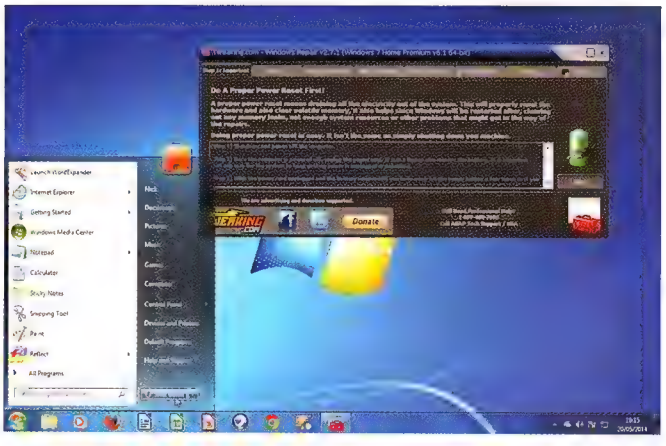

Tweaking.com - Windows Repair v2.7.1 (Windo
14 - Remove Temp Files
15 - Repair Proxy Settings
16 - Unhide Non System Files (3)
17 - Repair Windows Updates
18 - Repair CD/DVD Missing/Not Working
19 - Repair Volume Shadow Copy Service
20 - Repair Windows Sidebar/Gadgets
21 - Repair MSI (Windows Installer)
22 - Repair Windows Snipping Tool
23 - Repair File Associations (12)
23.01 - Repair bat Association
23.02 - Repair cmd Association
23.03 - Repair com Association
23.04 - Repair Directory Association
23.05 - Repair Drive Association
23.06 - Repair exe Association
23.07 - Repair Folder Association
23.08 - Repair inf Association
23.09 - Repair lnk (Shortcuts) Association
23.10 - Repair msc Association
23.11 - Repair reg Association
23.12 - Repair scr Association
24 - Repair Windows Safe Mode
25 - Repair Print Spooler
26 - Restore Important Windows Services
27 - Set Windows Services To Default Startup
28 - Repair Windows 8 App Store
29 - Repair Windows 8 Component Store
30 - Restore Windows 8 COM+ Unmarshalers
Defaults
Select All
Repair Options Selected: 35
System Monitor (Process Count: 50)
Drive Read: 90.04 KB/s
Drive Write: 706.81 KB/s
Memory Used: 1.18 GB
CPU Usage: 53.676%
Disable your Antivirus before running repairs. If the Antivirus g
the way at all it can keep some repairs from working.

Fix your PC



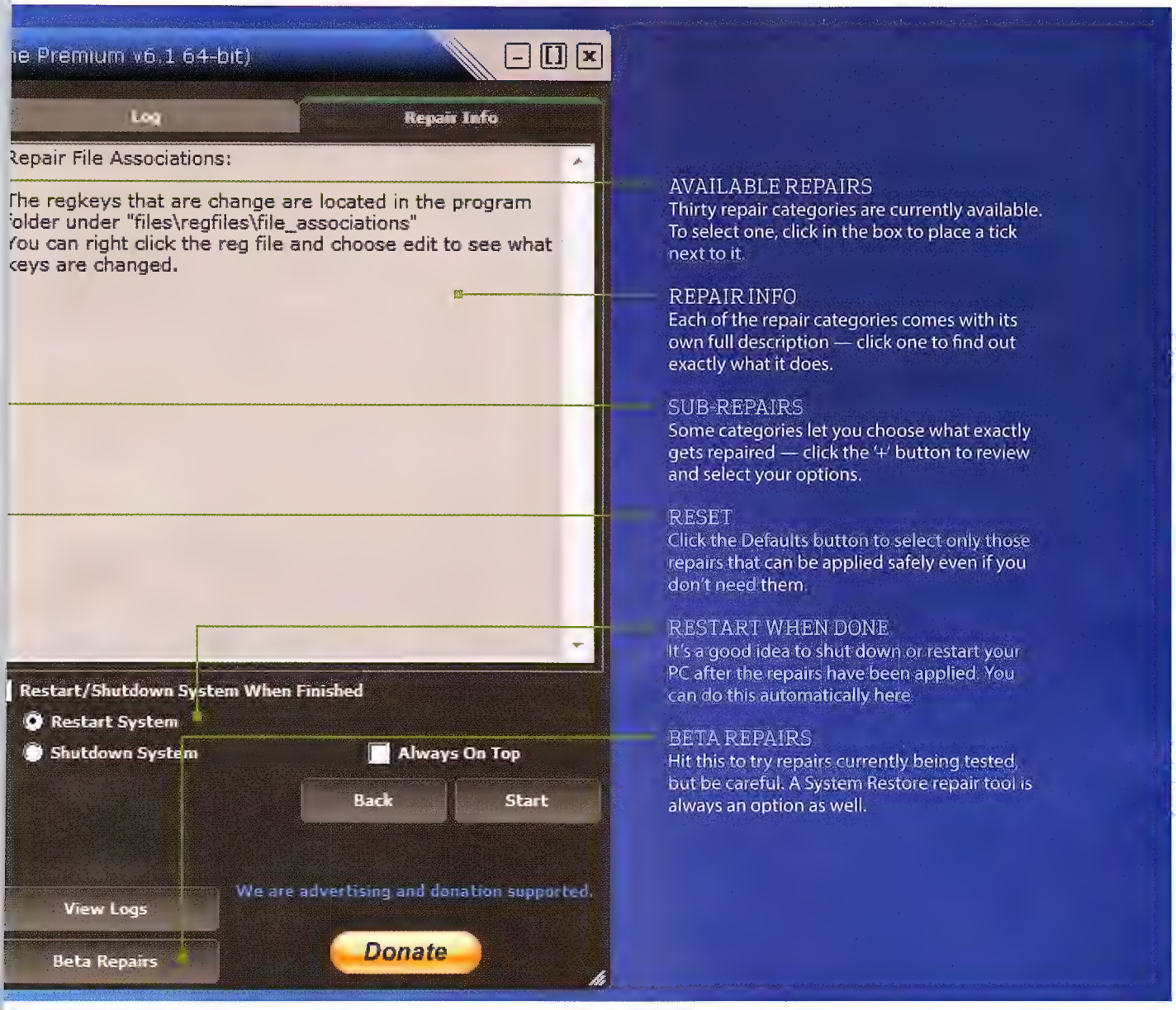
1 DOWNLOAD AND LAUNCH

Visit **www.tweaking.com** and click Programs then 'Windows Repair (All in One)'. Some problems may prevent you from installing new programs, so click the 'Direct download' link under Portable and save the zip file to your Downloads folder. Double-click this zip file and copy the folder on to your desktop. Open it and double-click the 'Repair_Windows' shortcut to begin.



2 POWER RESET

Click Yes when prompted. Windows Repair will check it has the files it needs — if any are missing, you'll need to re-download the zip file and start again. You'll now be prompted to do a 'power reset' — as instructed, power down your PC, remove all power cords and batteries, then hit the power button a few times to clear all power. Then reboot and restart Windows Repair.


Log
Repair Info
Repair File Associations:
The regkeys that are change are located in the program
folder under "files\regfiles\file_associations"
You can right click the reg file and choose edit to see what
keys are changed.
Restart/Shutdown System When Finished
Restart System
Shutdown System
Always On Top
Back
Start
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View Logs
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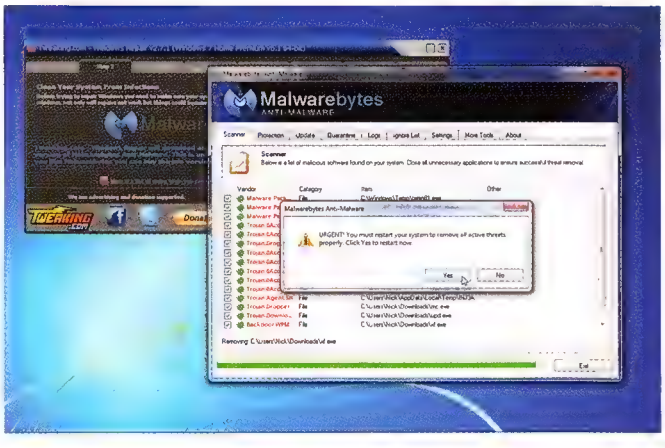
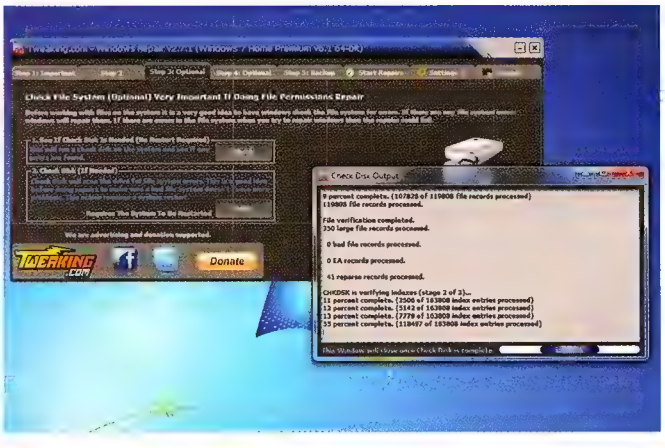
Donate
AVAILABLE REPAIRS
Thirty repair categories are currently available. To select one, click in the box to place a tick next to it.
REPAIR INFO
Each of the repair categories comes with its own full description — click one to find out exactly what it does.
SUB-REPAIRS
Some categories let you choose what exactly gets repaired — click the '+' button to review and select your options.
RESET
Click the Defaults button to select only those repairs that can be applied safely even if you don't need them.
RESTART WHEN DONE
It's a good idea to shut down or restart your PC after the repairs have been applied. You can do this automatically here.
BETA REPAIRS
Hit this to try repairs currently being tested, but be careful. A System Restore repair tool is always an option as well.



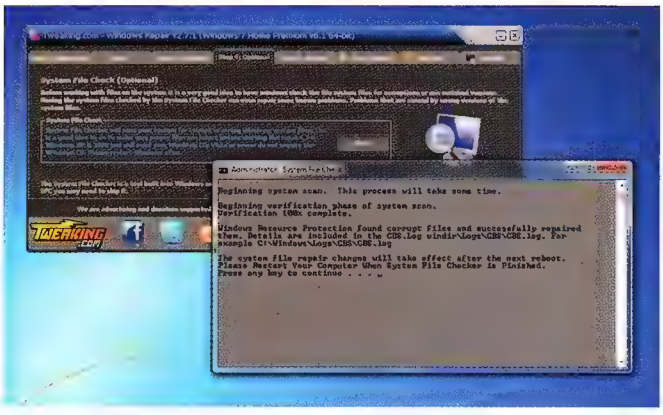


3 SCAN FOR INFECTIONS

Switch to the 'Step 2' tab. Run a full scan with your security software, then — if it's installed — run a full scan with Malwarebytes Anti-Malware. If you don't have it, click 'Download & scan system'. Windows Repair will download, install and update the program, then run a scan automatically. If threats are found, follow the instructions to remove them, rebooting if prompted.

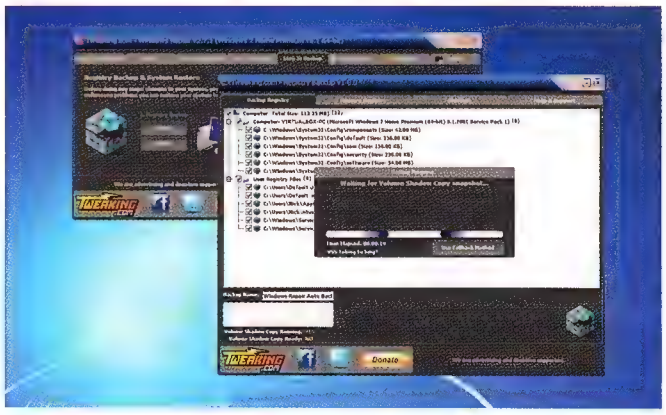
4 CHECK DRIVE FOR ERRORS

Once Malwarebytes has run and corrected any problems, close it and click Next. The following step is worth following even if you think your hard drive is fine. First, click the Check button to scan for errors. If any are found, click 'Do it' and let your PC reboot. The drive will be scanned again and fixes applied. Now restart Windows Repair, jump to step 3 and repeat the check. Repeat repairs if necessary.



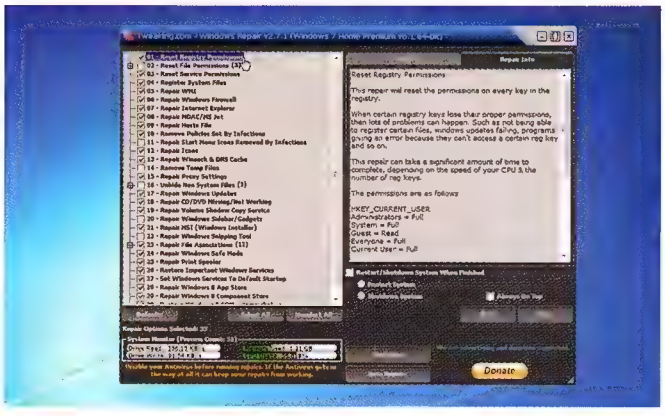
5 RUN SYSTEM FILE CHECK

When your drive has been given a clean bill of health, click Next. Read the instructions — XP users will need their installation CD at this point — then click 'Do it'. A command prompt window will open and the System File Check tool will perform its scan. If errors are found, press any key to exit, then restart your PC before running the check again to verify that all is now well.



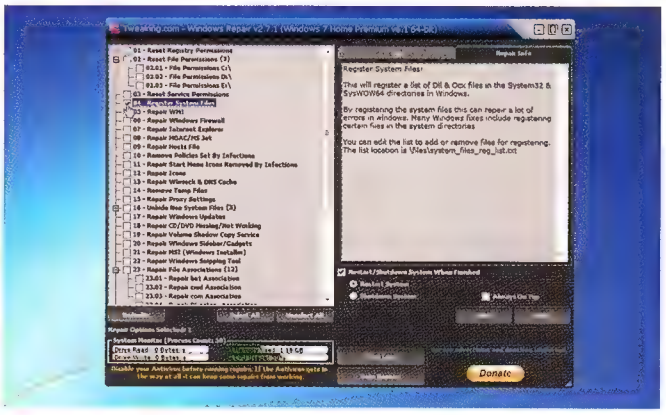
6 TAKE FAIL-SAFE BACKUPS

Click Next to move on to the 'Step 5: Backup' tab. Start by backing up the Registry files — click Backup under Registry Backup, then click Run twice if prompted. Wait a minute or two — if nothing happens, click 'Use fallback method'. Once complete, click Create under System Restore to add another level of backup. The cloud backup option isn't required, so click Next when done.



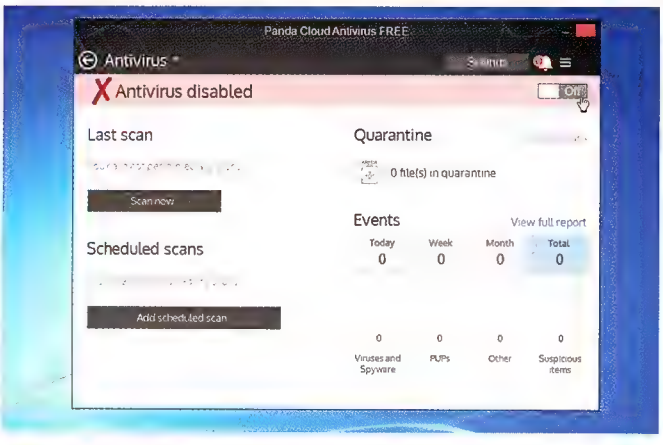
7 REVIEW FIXES

Read the disclaimer about the fixes offered, then click Start. A window will open that lists all the repair options available — 30 are in place at the time of writing, and more are being developed all the time. Some repairs are ticked by default — these can be safely applied even if they don't directly refer to your problem. To find out more about an individual repair, click its name in the list.



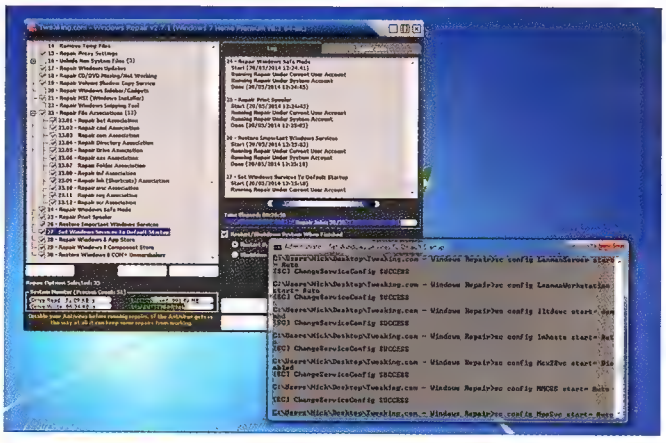
8 SELECT FIXES

Some fixes can take a while to process, so if you have an older PC and can see which fix or fixes should resolve your problem, click 'Unselect all' and then simply select each fix by clicking the box next to it. If you're unsure what could be causing your problem, start by clicking Defaults to select those repairs you can safely try without worrying about any side effects.



9 DISABLE ANTIVIRUS

Your security program may interfere with any repairs you attempt to perform. Before disabling it as recommended, physically disconnect your PC from the internet; the simplest way is to switch off your modem or router, or unplug your PC's Ethernet cable. Once done, open your security software's configuration tool and choose to disable its auto-protect feature.



10 APPLY FIXES

Once you've selected which fixes to apply, tick 'Restart/shut down system when finished'. Hit 'Restart system' and finally click Start. Depending on the repairs you've selected, the process may take a while. Once complete, your PC will reboot and hopefully the issues you've been having will be fixed. Don't forget to switch on your security software before reconnecting to the internet.

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Vigor2760 Series - VDSL2 / ADSL2+ Firewall Router with 2 x VPN tunnels

TAIWAN EXCELLENCE 2012

NBN READY

UFB READY

- Built-in VDSL2 / ADSL2+ modem
- Selectable Gigabit WAN / LAN (for NBN Connection Box or other xDSL / Cable modems)
- 4 x Gigabit LAN ports with 30,000 NAT sessions, IPv6, SIP Firewall, Web Content Filter and QoS
- 2 x VPN tunnels with hardware accelerator
- 2 x USB ports for 3G / 4G Backup, FTP server and network printers
- IEEE 802.11n Wireless LAN for Vigor2760n and Vigor2760Vn
- SIP VoIP (2 x FXS and 1 x Line port) for Vigor2760Vn
- Support TR-069 for VigorACS SI Central Management

Vigor2860 Series - Quad-WAN Firewall Router with 32 x VPN tunnels

TAIWAN EXCELLENCE 2013

NBN READY

UFB READY

- Quad-WAN Firewall Router with 1 x built-in VDSL2 / ADSL2+ modem, 1 x Gigabit WAN port & 2 x USB ports for 3G / 4G Mobile with Load Balance and Fail-Over
- 6 x Gigabit LAN ports with 50,000 NAT sessions, IPv6, SIP Firewall, Web Content Filter and QoS
- 32x VPN tunnels with VPN load balance and redundancy, Central VPN Management & 16 x SSL VPNs
- 2 x USB ports for 3G / 4G modems, FTP server, network printers & temperature sensor
- IEEE 802.11n Wireless LAN with Central AP Management for Vigor2860n / n-Plus / Vn-Plus
- Concurrent Dual-Band Wi-Fi for Vigor2860n-Plus and Vigor2860Vn-Plus
- SIP VoIP (2 x FXS and 1 x Line port) for Vigor2860Vn-Plus
- Support Smart Monitor Traffic Analyzer (up to 30-nodes)
- Support TR-069 for VigorACS SI Central Management

Broadband Professional Business Firewall Routers

Vigor3900

Multi-WAN Enterprise Firewall Router with 500 VPN tunnels

READY

TAIWAN EXCELLENCE 2012

- 5 x Gigabit WAN ports (4 x Ethernet & 1 x SFP) & 2 x USB ports for 3G / 4G Mobile with Load Balance and Fail-Over
- 3 x Gigabit LAN ports (2 x Ethernet & 1 x SFP) with 120,000 NAT sessions, IPv6, SIP Firewall, Web Content Filter and QoS
- High-Availability (with CARP) ensuring 24/7 system uptime
- 500 x VPN tunnels with VPN load balance and redundancy, Central VPN Management & 20 x SSL VPNs
- 2 x USB ports for 3G / 4G modems & temperature sensor
- Support Smart Monitor Traffic Analyzer (up to 500-nodes)
- Support TR-069 for VigorACS SI Central Management

Vigor2960

Quad-WAN Professional Firewall Router with 200 VPN tunnels

TAIWAN EXCELLENCE 2013

NBN READY

- 2 x Gigabit WAN ports & 2 x USB ports for 3G / 4G Mobile with Load Balance and Fail-Over
- 4 x Gigabit LAN ports with 80,000 NAT sessions, IPv6, SIP Firewall, Web Content Filter and QoS
- 200 x VPN tunnels with VPN load balance and redundancy, Central VPN Management & 20 x SSL VPNs
- 2 x USB ports for 3G / 4G modems & temperature sensor
- Support Smart Monitor Traffic Analyzer (up to 200-nodes)
- Support TR-069 for VigorACS SI Central Management

Vigor2925 Series

Quad-WAN Firewall Router with IPv6 & 50 VPN tunnels

TAIWAN EXCELLENCE 2013

READY

- 2 x Gigabit WAN ports & 2 x USB ports for 3G / 4G Mobile with Load Balance and Fail-Over
- 5 x Gigabit LAN ports with 50,000 NAT sessions, IPv6, SIP Firewall, Web Content Filter and QoS
- 50 x VPN tunnels with VPN load balance and redundancy, Central VPN Management & 25 x SSL VPNs
- 2 x USB ports for 3G / 4G modems, FTP server, network printers & temperature sensor
- IEEE 802.11n Wireless LAN with Central AP Management for Vigor2925n / n-Plus / Vn-Plus
- Concurrent Dual-Band Wi-Fi for Vigor2925n-Plus and Vigor2925Vn-Plus
- SIP VoIP (2 x FXS and 1 x Line port) for Vigor2925Vn-Plus
- Support Smart Monitor Traffic Analyzer (up to 50-nodes)
- Support TR-069 for VigorACS SI Central Management

i-LAN TECHNOLOGY

i-LAN Technology Pty Ltd trading as DrayTek Aust & NZ

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Prep your Mac for sale or donation

When your old Mac goes to a new home, there's no reason it shouldn't feel like a new Mac. Matthew JC. Powell shows you how it's done.

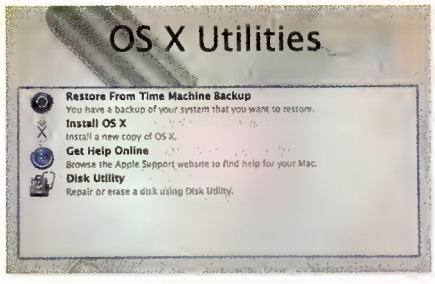
When you get a Mac out of the box and switch it on for the very first time, it's what Apple likes to call a "delightful" experience. The machine is fresh and clean and untouched – full of possibilities. Animations run, music plays, and you're welcomed into the world of Mac. When you decide to pass on a Mac to its next owner, it's probably not like that. In the worst case you might have left some personal data on it, but even if you've wiped it and reinstalled the OS, the new owner won't have that "new Mac smell" experience.

It's actually not that hard to get a Mac to fresh-from-the-factory condition, but there is a little bit of fiddling involved.

Step One: Clear out your stuff. The first thing you're going to want to do is make sure that nothing of yours is left on there. Back everything up to another drive using SuperDuper or a similar utility, or migrate everything to your new Mac using Migration Assistant if that's the path you're taking. Once all of your data is safe, wipe the old drive.

Obviously you cannot wipe the drive on which your system resides, so at this point you should restart your Mac from an installation drive (such as an OS X Install DVD or a USB installer). To do this, you either select the Installer from the Startup Disk pane of System Preferences, or hold down the Option button and reset your Mac.

When you boot from a DVD or USB Installer, you'll find you have a very limited system available to you but it will include Disk Utility. Open Disk Utility, click on the drive you want to erase in the left-hand column, then click on the Erase tab. To be on the safe side, click on Security Options, and drag the slider to the right. How far to the right you drag it will depend on how worried you are about your data – if you want to be very sure, go all the way to the right, but be aware that this will take a while.

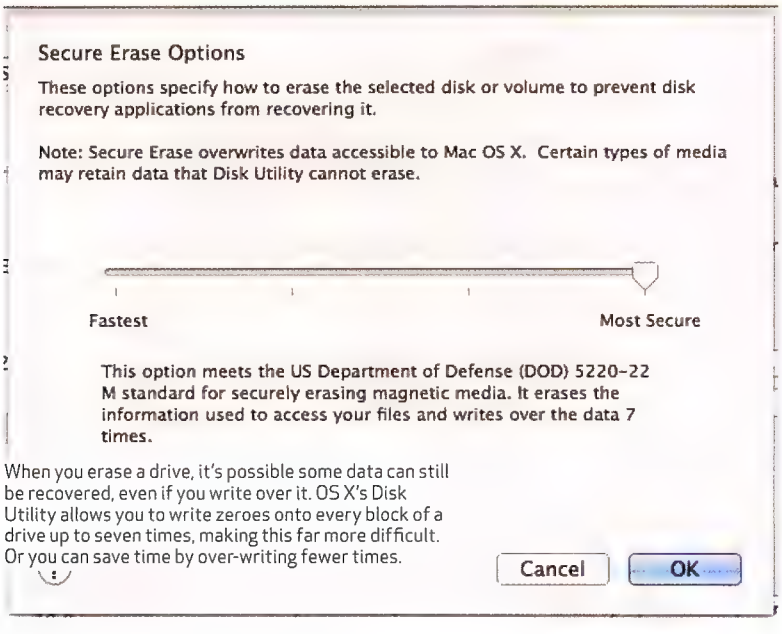

OS X Utilities
Restore From Time Machine Backup
You have a backup of your system that you want to restore.
Install OS X
Install a new copy of OS X.
Get Help Online
Browse the Apple Support website to find help for your Mac.
Disk Utility
Repair or erase a disk using Disk Utility.

The OS X 10.9 Installer gives you a few choices, including using Disk Utility to erase the drive you're installing it on — useful if you're passing the machine on to a new owner.

When you hold down the Option key while restarting, you can choose which drive to start up from. Here, we're using an OS X 10.9 Installer on a USB stick.

Step Two: Install the new OS. When that's done, install OS X on the drive, then boot up once again using the Install media. This time, select Terminal from the Utilities menu.

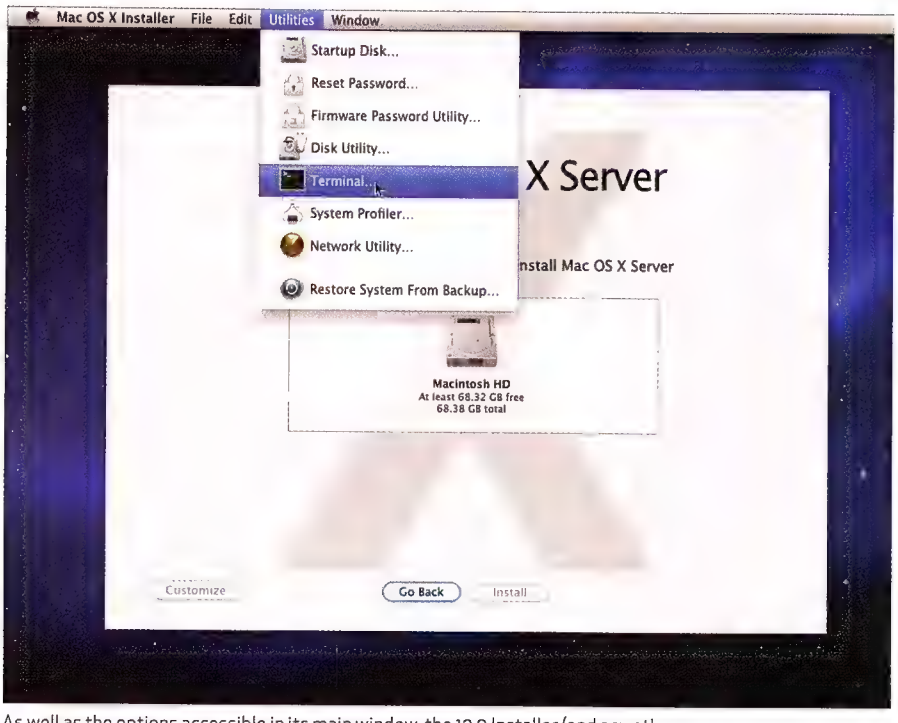
When the Terminal window opens, type `resetpassword` and hit return. The Reset Password utility will open, with icons for the drives attached to your Machine. Click on the one you just installed OS X on. You'll notice that the only user available on this disk is root – logical, since you haven't created any


Secure Erase Options
These options specify how to erase the selected disk or volume to prevent disk recovery applications from recovering it.
Note: Secure Erase overwrites data accessible to Mac OS X. Certain types of media may retain data that Disk Utility cannot erase.
Fastest
Most Secure
This option meets the US Department of Defense (DOD) 5220-22 M standard for securely erasing magnetic media. It erases the information used to access your files and writes over the data 7 times.
Cancel
OK

When you erase a drive, it's possible some data can still be recovered, even if you write over it. OS X's Disk Utility allows you to write zeroes onto every block of a drive up to seven times, making this far more difficult. Or you can save time by over-writing fewer times.

Reset Password
Select the volume containing the user account:
Mac OS ...stall Disc
Select the user account:
System Administrator (root)
Enter a new password for this user
Reenter the new password for this user
Enter a new password hint for this user (optional)
Save
Reset

One of the lesser-known Apple utilities is the Reset Password utility, which can be used to do all sorts of mischief in the wrong hands. Little wonder it's hard to get at, but you'll need it twice for this tutorial.



As well as the options accessible in its main window, the 10.9 Installer (and any other OS X Installer) gives you Terminal access via a menu option.

"The new owner will think it's straight off the lot."

others. Pick a password for the root user – any password will do because it's only temporary – and click Save. Then close the utility.

Go back to the Terminal window (which should still be open) and type the following:

```
touch /Volumes/Macintosh\ HD/private/var/db/.AppleSetupDone
```

This will create a file on the drive that tells the system all of the usual setup stuff that happens when a user takes their Mac out of the box has already been done, so you won't have to do it.

Now reboot the machine again, but this time start up using the newly-formatted drive. You'll notice that where you would normally have a list of users to select from, this time you'll have only one option, called Other. Click on Other, then enter root as the username, and whatever password you chose in the Reset Password utility. You should then be logged in.

Click on Software Update in the Apple Menu and install any required OS and Security updates, as well as any optional extras such as iTunes that might be there.

Step Three: Remove all traces. We fooled the mac into thinking it was already set up, but the point of this exercise is to let the new owner set it up, so now we need to cover our tracks. Open the Terminal and enter the following:

```
rm /private/var/db/.AppleSetupDone
```

This will delete the file we created earlier, so the Mac will go through the setup routine again when the new owner starts it up.

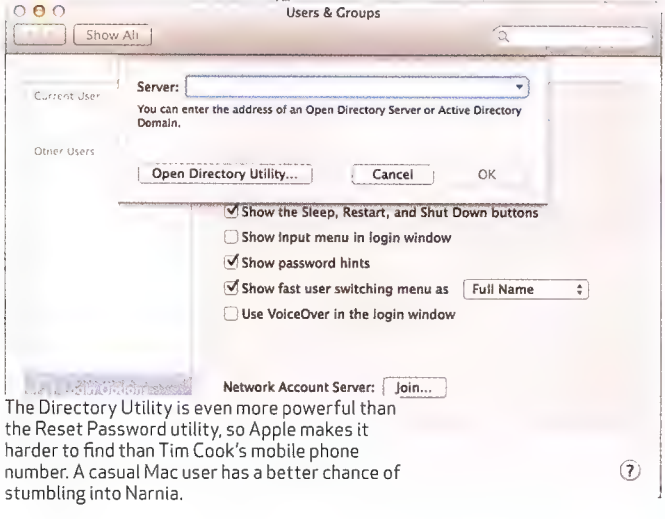
Next, we need to open the Directory Utility. Like the Reset Password utility, it's a very powerful tool, so Apple makes it a bit tricky to get to. Open System Preferences and click on Users & Groups. In the left-hand column, click on Login Options, and you'll see a range of options including Network Account Server with a single button next to it labelled Join. Click that button, and the resultant dialog will have a button on it labelled Open Directory Utility. That's the secret entrance: click it.

And for all that fiddling, there's only one thing we need to do with the Directory Utility. Go to the Edit menu, and select Disable root user (don't worry, you can actually do that even when you are logged in as root). Once that's done, close the utility.

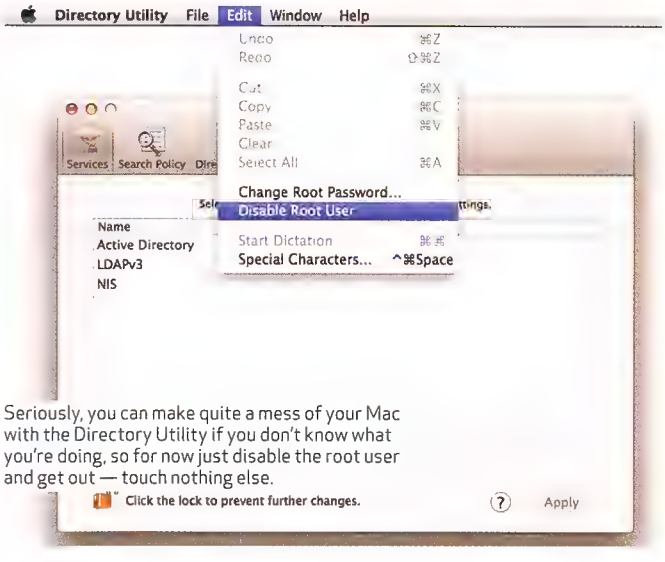
Next you need to go back to the Password reset Utility, so reboot using the Install media as your startup drive again, open Terminal again, and type `resetpassword` and hit return. Click on the new drive and select the root user. Rather than changing the password again, though, all you want to do is click the Reset button in the bottom section of the window, which will reset the permissions and Access Control Lists (ACLs) of the home folder to factory defaults.

Reboot once more into the startup drive instead of your Install media, remove the USB or DVD you've been using, and shut the computer down without setting anything up.

The new owner will think it's straight off the lot. ■


Users & Groups
Show All
Server:
You can enter the address of an Open Directory Server or Active Directory Domain.
Open Directory Utility...
Cancel
OK
Show the Sleep, Restart, and Shut Down buttons
Show Input menu in login window
Show password hints
Show fast user switching menu as
Full Name
Use VoiceOver in the login window
Network Account Server:
Join...

The Directory Utility is even more powerful than the Reset Password utility, so Apple makes it harder to find than Tim Cook's mobile phone number. A casual Mac user has a better chance of stumbling into Narnia.



Seriously, you can make quite a mess of your Mac with the Directory Utility if you don't know what you're doing, so for now just disable the root user and get out — touch nothing else.

Browse anonymously on iOS

Rosie Hattersley shows you how to keep your surfing habits to yourself.

Many of us are becoming more and more concerned about having our online activities tracked. Some of us want to avoid marketers and spam, while others want to dodge overzealous content blocking from their internet service provider.

Generally, though, most of us just want to use the internet as we please without our browsing being snooped on and logged by the authorities.

The iPad's web browser, Safari, usually tracks your web movements with cookies that enable you to quickly return to the pages and products you've looked at previously.

It also saves your web history, which can be useful if you want to quickly return to a page you've visited before.

You can use a Private version of Safari that doesn't track you in this way, as we show you below.

However, for proper privacy it's better to use a proxy server that masks your real details. So here's how to temporarily surf in secret in Safari, and how to use the Tor network and the Onion web browser to surf stealthily all the time.

Hide your location and surf in secret

The Tor network automatically disguises your web location.

Get a new IP identity

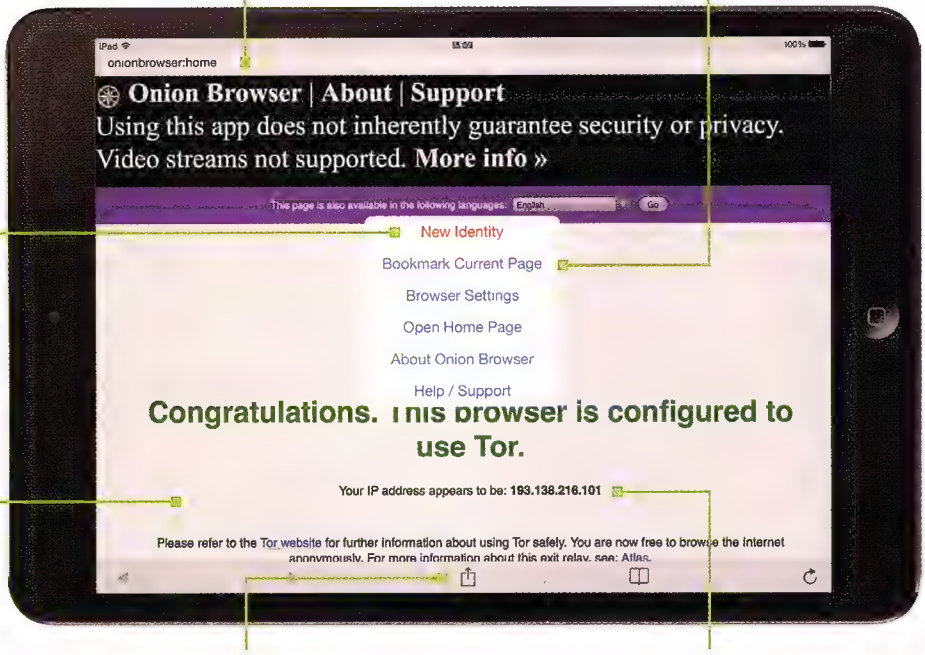
You don't need to be Julian Assange to be worried about who can track you down. If you think your cover might be blown, tap the arrow at the bottom of Onion Browser, then tap New Identity in the menu that appears. A new IP address will be generated for you.

Use anonymous search

You can now explore the web using Onion Browser. The browser works well with the DuckDuckGo (**duckduckgo.com**) search engine, which prides itself on its lack of tracking — great for an anonymous web search.

Bookmark useful pages

Because Onion Browser doesn't save your web history, you need to type in the complete URL of any website you want to visit, each time you go there. It's not entirely lacking in functionality, however: you can still bookmark useful sites in the usual way by tapping the menu arrow at the bottom of the page and then Bookmark Current Page. To view these Onion bookmarks, tap the book icon at the bottom right of the page.


onionbrowser:home
Onion Browser | About | Support
Using this app does not inherently guarantee security or privacy.
Video streams not supported. More info »
New Identity
Bookmark Current Page
Browser Settings
Open Home Page
About Onion Browser
Help / Support
Congratulations. This browser is configured to use Tor.
Your IP address appears to be: 193.138.216.101
Please refer to the Tor website for further information about using Tor safely. You are now free to browse the internet anonymously.

Use Tor

Install Onion Browser ($1.29 from the App Store), tap to launch it and allow it to connect to the Tor network. The initial connection will take up to a minute.

Unstick Onion Browser

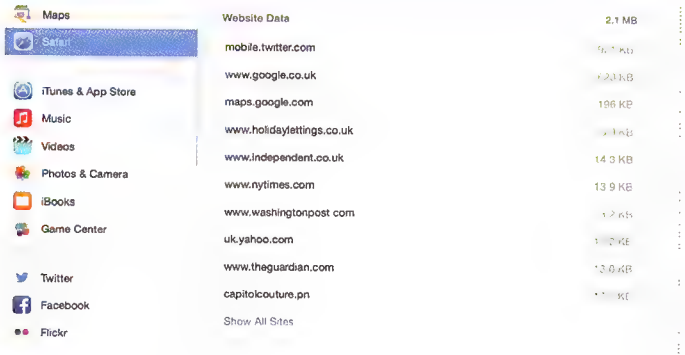
Sometimes, typing in a web address in Onion Browser has no effect. This is because it occasionally conflicts with dormant apps in iOS. Tap the arrow at the bottom of the browser screen to bring up its menu, then tap Help/Support and click the force-quit link. Then launch Onion again to start a new session.

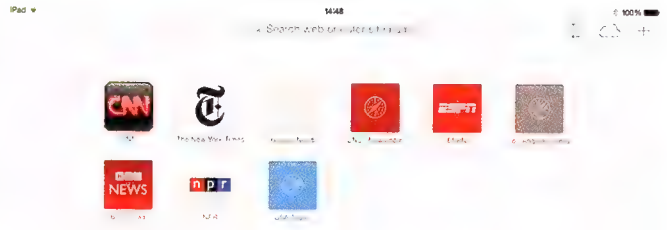
Spoofing your IP address

Once your iPad is connected to **check.torproject.com** you'll get a message confirming that your web surfing is now being routed through it. You'll see a message showing the IP (internet protocol) address that your iPad now pretends to be using — called spoofing.

Safe on Safari

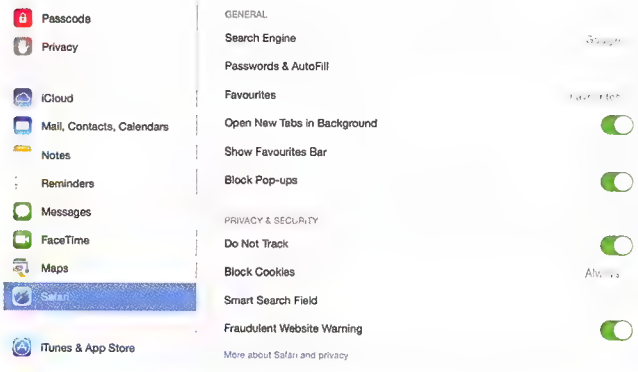
Use these tips to secretly surf the web.





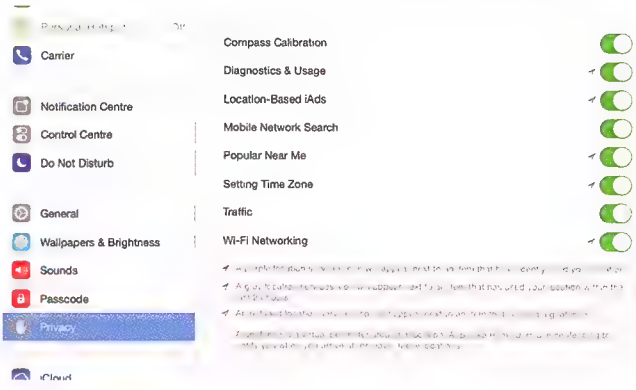
1 DELETE YOURSELF

If you're worried about someone checking which web sites you've visited, delete your Safari browsing history by tapping 'Settings > Safari > Clear History' and also 'Clear Cookies and Data'. Next, tap 'Advanced > Website Data', and tap 'Remove All Website Data'. To stop subsequent web surfing being snooped, use a private browsing session. Launch Safari and then tap the + sign in the top right. Tap Private in the bottom-left corner.



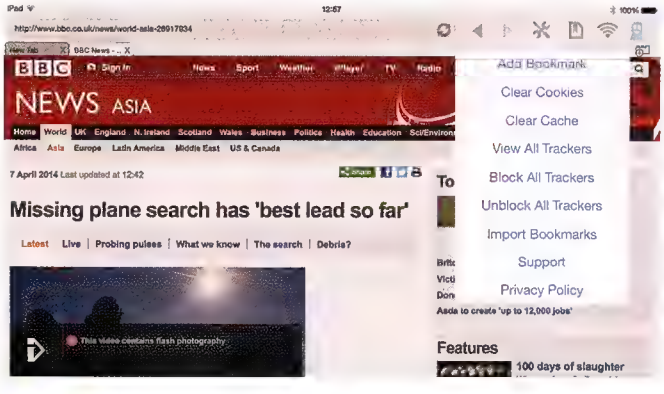
2 START A PRIVATE SESSION

A 'Close All Tabs?' query box now appears. Tap either 'Close All' or 'Keep All' depending on whether you want to return to those open web pages later. When you surf in Private mode in Safari, web pages are distinguished with a black URL bar. Otherwise, you can browse the web as normal. Tap Private again to revert to standard web browsing. You'll get another prompt about keeping tabs for sites you've just visited.



3 LOSE TRACKERS

Safari has a Do Not Track setting you can switch on permanently, as well as an option to limit the amount that your web browsing is logged. In Settings, tap 'Safari > Privacy & Security' and turn on 'Do Not Track'. Not all advertisers respect it, but enabling this option will stop some of them tracking you. We also recommend you turn on Limit Ad Tracking and reset the Advertising Identifier under 'Settings > Privacy > Advertising'.



4 LIMIT LOCATION TRACKERS

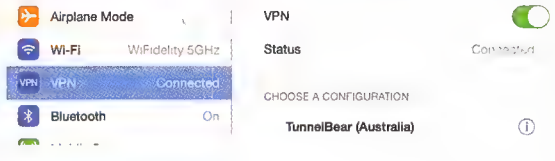
Apps that don't really require your location often collect and report it to help advertisers target ads. You can turn off Location Services in 'Settings > Privacy > Location Services' but this is a bit drastic. Instead, switch off other apps individually in the Location Services screen. Tap System Services at the very bottom and switch off Diagnostics & Usage, Location-Based iAds and Popular Near Me. Finally, tap Status Bar Icon to On.

5 LEARN WHAT TRACKS YOU

Although lots of services log what you do online, the purpose of this tracking varies greatly. To see what web trackers are active, install the free Ghostery app from the App Store. This lets you block or allow trackers and analytics tools on a case-by-case basis. Ghostery also includes the DuckDuckGo search engine mentioned earlier. Tap the blue Ghostery tool icon in the browser to select View All Trackers, Block All Trackers and so on.

Private networks

Tor is really useful if you need to be sure that no one can identify your iPad or the sites you visit, but it's slow. Another way to surf privately is to use a VPN. This creates a 'tunnel' through which your iPad establishes a web connection. If you need to send private emails at an unsecured Wi-Fi hotspot, using a VPN is a must. Install TunnelBear VPN (free from the App Store with IAP), create an account, then allow TunnelBear to install its VPN software profile on your iPad. Type your iPad unlock passcode to confirm and tap Done. To use TunnelBear, select it from the 'Settings > VPN' menu and tap VPN to enable it. The status will then show Connected.



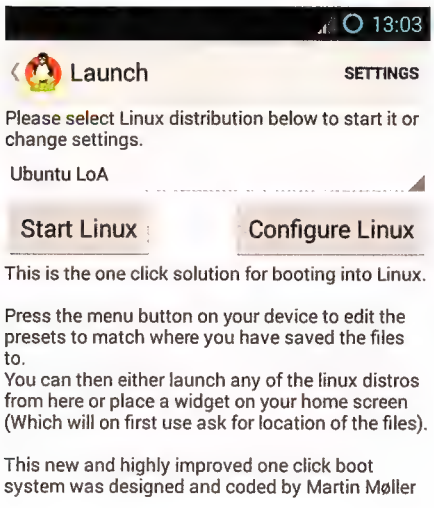
Run Linux on your Android phone

Mayank Sharma shows you how to unleash the power of your smartphone by running a fully fledged Linux distro on it.

Your Android phone is already powered by the goodness of Linux, but you can enhance it further and make better use of its multi-core processors and oodles of RAM by running a full-blown Linux distro alongside the existing mobile OS.

We can think of many reasons why you'd want a proper Linux PC in your pocket. You can, for example, use it to power a LAMP server that can run web apps and serve web pages. If you're a network admin, you can install your favourite Linux tools and turn the smartphone into a portable network-troubleshooting or pen-testing device.

The LinuxOnAndroid project produces an Android app and a couple of shell scripts, and hosts a bunch of Linux distros that you can boot using the app. In a snap, the scripts mount the Linux image within the Android filesystem and the SD card within the Linux filesystem. They then call on chroot to change the root directory to that of the mounted Linux and open up a shell for you to interact with the mounted Linux system. The scripts also set up SSH for secured remote access, along with VNC so you can see this Linux system's graphical desktop.


13:03
Launch
SETTINGS
Please select Linux distribution below to start it or change settings.
Ubuntu LoA
Start Linux
Configure Linux
This is the one click solution for booting into Linux.
Press the menu button on your device to edit the presets to match where you have saved the files to.
You can then either launch any of the linux distros from here or place a widget on your home screen (Which will on first use ask for location of the files).
This new and highly improved one click boot system was designed and coded by Martin Møller

The CompleteLinuxInstaller app makes adding a distro a straightforward step by step process.

The scripts only prepare the environment for Linux to run on the device. The Linux image files hosted by the project are just customised Linux environments packaged by the project developers to suit different use-cases and devices.

The important bit is that all the Linux distros offered by the project are made up of ARM packages, and instead of running in a virtual machine they run on the real hardware on your Android smartphone. This is why you can run it on the measliest of devices. We've managed to run Arch Linux along with the Enlightenment desktop on a Samsung phone with a single-core 1GHz processor and about 400MB RAM.

At the time of writing, the project has stable images for Arch Linux, Debian Lenny, Debian Testing, Fedora 20, Fedora 19, Kali Linux, Ubuntu 13.10, Ubuntu 13.04, and Ubuntu 12.04 LTS. There are also Alpha images that aren't meant for production use for other distros, including Slackware, Bodhi, OpenSUSE and Ubuntu 14.04. Each of these distros is available in multiple editions.

The Core image is the smallest in size, and includes the minimum set of packages you need to run the distro. This is ideal for creating your own images and include the Openbox window manager. Next there's the Small image, which ships with the LXDE desktop and its suite of programs. Finally you have the Large image, which includes the KDE Plasma Desktop, LibreOffice and Gimp.

Some distros have additional images as well. Arch Linux produces images with the Enlightenment desktop, and Fedora ships an image with the MATE desktop. You can grab the images with either the ext2 or ext4 filesystem.

The ext4 images are compatible with Android 4.3 while the ext2 images are compatible with earlier versions of Android.

Quick tips

The LinuxOnAndroid project is entirely open source.

You can grab the source code for the app, as well as the scripts, from the project's web site. You can download the distro images from within the app, or you can grab them from the project's web site and transfer them on to the phone.

To remove a distro, make sure it isn't in use and then remove the folder that houses the relevant IMG file.

PREP THE DEVICE

Start by grabbing the Complete Linux Installer app from Google's Play Store. Alternatively you can head to the project's web site (**linuxonandroid.org**) and download the open source version of the Android app (but go into the 'Settings > Security' menu and toggle Unknown Sources to enable installation of non-Play Store apps).

The app requires a rooted Android device. The exact procedure necessary to root an Android device varies between models so check online for the best options for your device.

Besides the app produced by the LinuxOnAndroid project, you'll also need a VNC viewer to use the graphical desktop. The project suggests using the popular Android VNC Viewer app. You'll need another app to access Android's built-in command line, but you'll already have this if you've rooted your device. In any case, the project suggests using the Android Terminal Emulator app.

Once you've grabbed these, you can launch the CompleteLinuxInstaller app. Tap on the project's icon in the top-left corner of the screen to reveal the navigation menu, which contains several items. The first two are the most important: Install Guides will take you through the steps required

for setting up and installing the various supported Linux distros, and the Launch item is the integrated launcher that you can use to boot into the configured distro. The other items will bring up various information and tips to assist you.

To begin the process of setting up a distro, launch the CompleteLinux Installer app, bring up the navigation menu and tap on the Install Guides item. This will bring up a list of distros that you can run on your device. Once you've decided which distro to run, tap on its entry for further instructions. For this tutorial, let's assume you want to set up Ubuntu 13.10. However, note that the process to set up a distro is pretty much similar for all.

SET UP A DISTRO

Once you've selected a distro, the app will display detailed instructions broken down into four pages. On page 1 the app runs through the basic requirements your device must meet to be able to run a Linux distro. The most important step is to make sure that you've enabled the debugging support. To do that, head to 'Settings > Applications > Development' and make sure the USB Debugging setting is toggled.

On the seond page you get links to download the image for the selected distro. Tapping on the Download Image button pops up a window with three additional buttons to download one of the three supported image types explained earlier – Large, Small or Core. The page also mentions details about the offered images, such as the size of the compressed image that you'll download as well as the size the image will take on your SD card once it's been extracted.

Tapping on the image you wish to download brings up another pop up with buttons that'll either download the image from a Sourceforge mirror or via torrent. If you choose the torrent option, the app will download a torrent file, which you'll then have to feed to a torrent client to download the actual image for your selected distro.

You can download the image on a computer and then transfer it on to the SD card on your Android device. In this case, you can safely skip the instructions on this page. You can uncompress the downloaded file either on the computer or on the device itself. For the latter, you'll need a versatile file manager such as the paid-for Root Explorer app or the free ES File Explorer app.

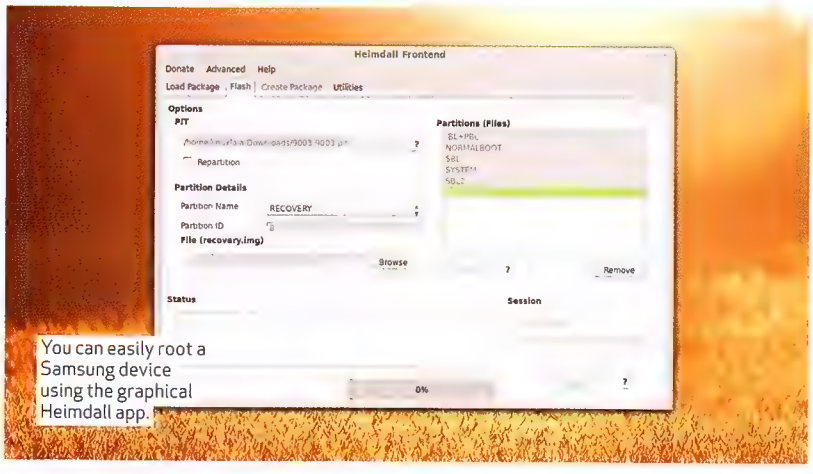
While compressed files are smaller and are faster to transfer than uncompressed ones, remember that they are tightly compressed and (depending on the specs of your Android device) can take some time to deflate. However, if you're moving the images on to your device manually, it's best to house them inside a folder. For example, if you're downloading the image for the Ubuntu 13.10 distro, it's best to uncompress it inside a folder called Ubuntu on your SD card.

Then move on to page 3, which advises you on extracting the downloaded files. The rest of the page talks about how to boot the extracted images. Once booted, you'll be dropped to a terminal window. Page 4 lists instructions on how to connect to this running Linux installation via a VNC viewer. Remember to note the password listed on this page as you'll need it to connect to the VNC server running inside your distro.

BOOT THE DISTRO

You're now all set to boot the new distro. Bring up the navigation menu by tapping on the app's icon or swiping from left to right and tapping on the Launch item. This will bring up the app's launcher which is responsible for booting the distros. Use the pull-down menu on the page to select the distro you wish to boot.

"Once you've decided which distro to run, tap on its entry for further instructions."



You can easily root a Samsung device using the graphical Heimdall app.

A generic guide to rooting your Android phone

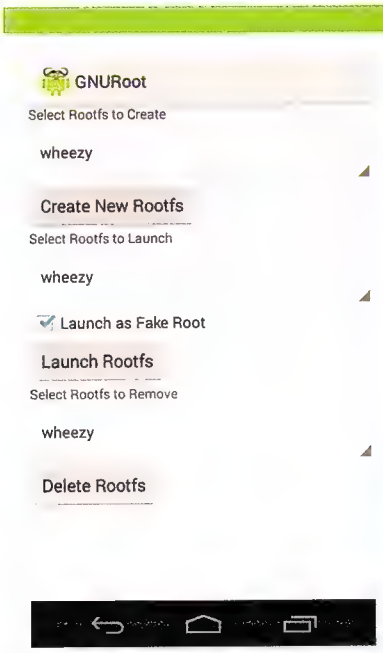
Set your phone up how you want it to be.

In layman's terms rooting a device gives you access to parts of the operating system that the device vendor doesn't want you to tinker with. In other words, a rooted phone gives you greater privileges or administrator control to the lowest level of Android's Linux subsystem.

To get there you need to swap out some core components inside the device starting with the bootloader. The default bootloader on your phone is locked and will only start the system it trusts (this is eerily similar to the Secure Boot functionality on the desktop). In order to get root access you need to unlock the bootloader, replace the recovery system and install a superuser app.

Start by installing the android-tools-fastboot tool using your distro's package manager. This lets you interact with the deeper levels of the device. You'll then have to reboot the device into the Fastboot mode. Browse the web for the key combination that enables you to do this for your device. The process to unlock the bootloader also varies depending on the device manufacturer. For Google devices, such as the Nexus 4, you can do it with a simple fastboot oem unlock command. For other devices you'll need to request a key from the manufacturer.

Then grab an alternative recovery system image that fits your phone from the popular ClockWorkMod project at **www.clockworkmod.com/rommanager**. Once you have the IMG file for your device you can flash it with the fastboot flash recovery <image name> command. Finally, grab an app to manage superuser permissions, such as Superuser developed by the CWM project or the popular SuperSU app.



Enable use of the distro's CLI package manager tools with GNURoot. The developers are currently working to get a graphical interface for the desktop.

Run Linux without rooting your device

You can run Linux even on an unrooted Android device thanks to the GNURoot app.

Despite its name, this app doesn't require a rooted phone. The one major difference between CompleteLinuxInstaller and GNURoot is that the latter only gives you access to the command line interface of the Linux distro.

To run Linux on your Android device via GNURoot, you'll need to grab it from the Play Store, as well as a companion app for the specific Linux distro. The app produces companion apps for popular distros, such as Debian, Gentoo, and Fedora. Remember that these apps are close to 100MB in size, unlike the GNURoot app, which is a just a few KB.

Once you have them both installed, fire up GNURoot and use the drop-down menu at the top of the page to select the distro you wish to boot. Make sure you have already downloaded its companion app. Then tap on the Create New Rootfs button to install the distro which will take some time depending on the resources on your device. When it's done, tap the Launch Rootfs button which will open a terminal and log you in the distro. If you select the Launch as Fake Root checkbox before launching the distro, you'll be logged in with superuser privileges.

If you get an error saying that the image for the selected distro doesn't exist, it means that the app can't locate the extracted image files for the distro. This can happen if you haven't extracted the downloaded file, or if you've kept it in a non-standard location. In such a case, you'll have to point to the IMG file of the distro manually. Tap on Settings in the top-right corner inside the Launch screen which brings up a pull-down menu. Tap on Add to open the page to add an entry for your distro. Enter the name for the distro in the space provided and tap on the box with three dots to navigate the filesystem on your Android device and point to the IMG file for the distro. Tap on Save Changes when you're done.

This custom entry from your distro will now be listed in the pull-down menu on the Launch page. When you now select the entry, the app will show you a button to start the distro. Tap on the button to boot the distro. This will launch the terminal app and grant it super user permission. Press the Enter key in the virtual keyboard to boot the distro.

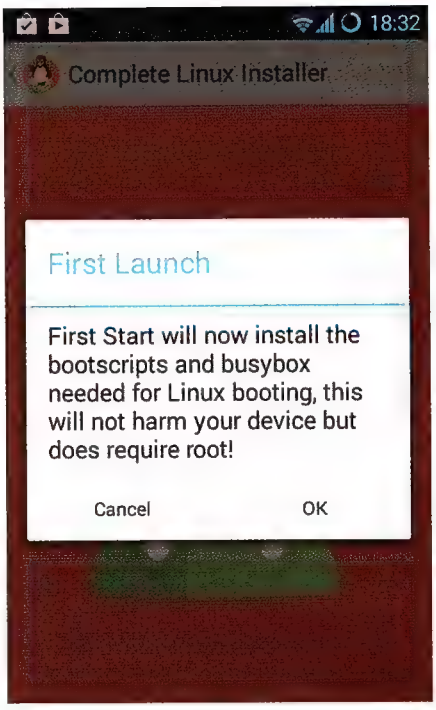
Since this is the first time you've started up the distro, you'll be asked to specify a password for the default user (which in the case of the Ubuntu distro is named ubuntu). Note that this is the password for the default user account and not the password required to log into the VNC session.

You'll then be asked if you want the distro to start the VNC server (for viewing the graphical desktop) and the SSH server (for accessing the distro remotely over a secure connection). We suggest you start them both to reap the full benefit of running a Linux distro on your Android device.

Next, you'll be asked to enter the screen resolution of the VNC session. Although you can set this to any size, for best experience you should set it to the same resolution as your device. Remember, however, that when you bring up the virtual keyboard it will hide a part of your desktop. If you are running this on a device with a big screen you can follow the guide on the project's wiki to adjust the screen size to accommodate the soft keys.

That's all the configuration it requires. The app will then prompt you to save the settings as default. It's safe to do so to avoid answering the same questions every time you launch the distro. We'll show you how to alter these settings a little later on in the tutorial. For now you should just save the settings as default and let the app boot your distro.

When it's done booting your distro, you'll see a note with the relevant settings you need to connect via VNC to this Linux distro, followed by the


18:32
Complete Linux Installer
First Launch
First Start will now install the bootscripts and busybox needed for Linux booting, this will not harm your device but does require root!
Cancel
OK

The Installer requires BusyBox to boot Linux which it will go ahead and install on first launch.

standard Linux root prompt. If you're proficient with the Linux command line interface, you can now use this shell to interact with the distro like any desktop distro.

For security purposes, one of the first things you should do is set a new password for the root user. Enter `passwd` in the shell and enter a new password for the root user. If you've asked LinuxOnAndroid to start the SSH server while booting your distro, you can now connect to it from any computer on the network. Enter the `ifconfig` command inside the terminal on your Android device, which will print the IP address of the device, such as 192.168.2.101.

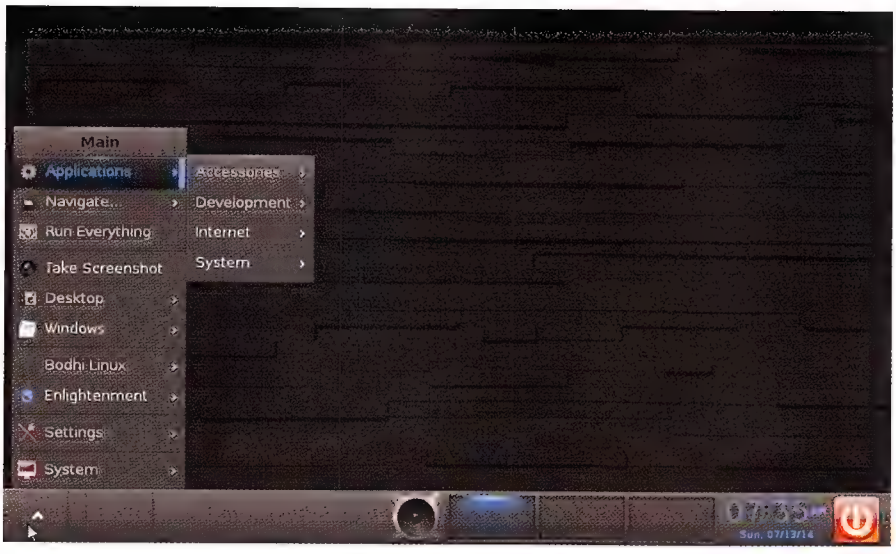
To connect to the device launch a terminal on another computer and enter

```
ssh ubuntu@192.168.2.101
```

This will prompt you for the password for the ubuntu user which is the one you set when you first booted the distro.

To view the graphical desktop running on top of your Linux distro on the Android device, tap on the home button to minimise the terminal app, then tap and launch the VNC app (such as androidVNC).

The VNC app will prompt you for various settings so it can connect to the distro running on the device. Enter `localhost` in the field that asks you for the IP address of the VNC server and `5900` as the port. In addition to these you'll also need a password to authenticate with the VNC server. This varies from distro to distro. For the Ubuntu images, the password is



Make sure your Android device uses an ARM v7 CPU since most distros only support that particular ARM architecture.

"The app also offers some other options to further customise the distros and tweak your user experience."

ubuntu. For Arch Linux it's archlinux, for the Debian flavours it's debian and so on. The password is listed on the distro's wiki page on the LinuxOnAndroid project's web site.

Note that if you are using androidVNC, the app suggests that you change the colour format to 24-bit color (4bpp). Tap the Connect button to initiate the VNC session once you've entered all the information and hey presto! The VNC client will connect to your device and display the graphical desktop that's running inside the distro you're currently running.

Again, the app developers advise androidVNC users to change the input mode to touchpad. To do so, tap on the menu button from inside the VNC session. This will bring up a bunch of options; you need to tap on Input Mode and then select the Touchpad radio button from the list of supported input modes.

You can now interact with and operate the desktop just like you would on a PC. On the androidVNC app, a single tap equates to a left-click. Tap twice to simulate a right-click. If you tap and hold, the app will display three buttons — two to zoom in and out, and one to display the virtual keyboard.

You can also use the package manager to install new apps. Remember, however, that the distro will only be able to install apps that have been ported for the ARM architecture, which is true for almost every popular app.

When you've finished, close the VNC session by logging out of the desktop. Now pull down the app drawer and tap on the terminal session that's been running in the background. Type `exit` to shut down the Linux distro. When the distro shuts down you'll have to type the exit command a couple more times to exit and close the terminal session completely.

ADVANCED TWEAKS

You can use the steps described above to download, set up, boot and use any of the supported distros on your device. However, the app also offers some other options to further customise the distros and tweak your user experience.

For starters, you may wish to change the settings of the distro you specified when you first booted into it. To do so, select the distro you wish to customise from the drop-down list in the Launch section. In addition to the Start Linux button, you'll also see a Configure Linux button. Tap on it to bring up the settings page.

Here you'll find checkboxes for enabling and disabling the start of the SSH and VNC servers. You can also modify the resolution of the VNC screen by altering the values listed on this page.

The page offers a couple of interesting options, including the Create 1GB SWAP File checkbox. As you can imagine, when this is toggled, the app will create a swap file for the distro to use. Make sure you have adequate free space on your SD card before you enable this option.

The app can also mount folders from the Android filesystem into the running Linux. Tap on the Configure Mounts button to launch the mount editor. Tap on Options in the top-right corner and then on the Add Mount option. This pops up a page where you'll have to specify the location of the Android folder you wish to share manually (such as /storage/sdcard0/Downloads), followed by the path where you want to mount it (such as /home/ubuntu/Downloads). You can add as many folders as you wish. When you're done tap on the Save Changes button and exit the mount editor.

When you now boot into the distro, LinuxOnAndroid will mount the listed Android folders in the specified locations inside the distro.

Depending on how you use the distro, sooner or later you'll run out of space inside the image. In such a case you'll have to make a larger image and copy over all the files and folders from inside the existing image to the new one.

Start by firing up a terminal and creating a blank image of the size you want. For example, the command:

```
dd if=/dev/zero of=ubuntuNEW.img bs=1M count=0 seek=4096
```

will create a 4GB image called ubuntuNEW.img. Then you'll need to format this new image and create a filesystem. The command:

```
mke2fs -F ubuntuNEW.img
```

should do the trick. Then copy the image file that you want to inflate from the device into your computer. Let's call it ubuntuOLD.img. Now create two folders on your desktop (ubuntuNEW and ubuntuOLD) to mount these images. The commands:

```
sudo mount -o loop ubuntuOLD.img ubuntuOLD/
```

and

```
sudo mount -o loop ubuntuNEW.img ubuntuNEW
```

will mount the images into their respective folders. Once that's done, copy over all the files from the old image to the new image. The command:

```
sudo cp -rp ubuntuOLD/* ubuntuNEW
```

will make sure the files and folders are copied along with their ownership permissions. Round up the process by simply unmounting the images with:

```
sudo umount ubuntuOLD
```

and

```
sudo umount ubuntuNEW
```

You can now transfer the ubuntuNEW.img file to your phone, remove the existing image and make sure the distro's entry in the Launch screen points to the new image.

Pi-powered privacy protection

Spooked by spooks monitoring your online activities? Then you need Tor and a Raspberry Pi.

Tor is an acronym for The Onion Router and it enables you to browse the web anonymously. The goal of the software is to prevent other people from discovering your location or tracking your browsing behaviour.

Under normal circumstances, when you visit a web site, your computer establishes a direct connection between itself and the web site. The web site knows your IP address and where you are coming from, and your ISP (or a busybody boss or an intrusive organisation) knows which web sites you are visiting.

Tor thwarts their surveillance by creating a network of relay nodes right across the internet. Whenever you visit a web site using Tor, the data to and from your computer is bounced around these nodes before ending up at the intended web site. This masks your origins from the web site and no one knows where the network traffic from your computer is headed.

The only downside to using Tor is that web sites load slower than usual because the data to and from the web site passes through so many relay nodes in the middle.

The Tor project produces a special bit of software known as the Tor Browser Bundle, which includes everything you need to connect to the Tor network of relays, including a customised version of the Firefox browser, known as the Tor Browser. You can install the bundle on your hard disk or on a portable USB flash drive.

The Tor Browser Bundle works best if you have a couple of computers, but if your network has several computers, you can install Tor on one and then set it up as a proxy server which the other computers use to browse the web. While you can use any computer in your network as the anonymous proxy server, it's best to relegate this task to a dedicated always-on machine.

SET UP TOR

Before you begin installing software, make sure the computer that will act as the server has a static IP address. You can do this from your router's admin page. For this tutorial, let's assume the server is 192.168.1.100.

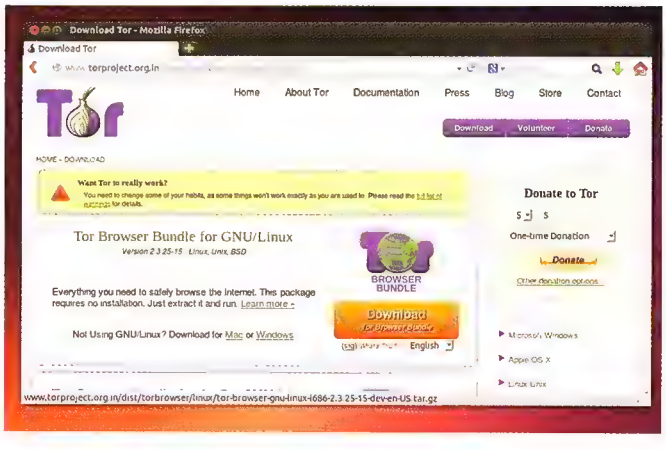
The command `sudo apt-get install tor vidalia` pulls the required software from the repos. Vidalia is the graphical controller for Tor. If the package manager is unable to locate the packages, make sure the Universe repository is enabled.

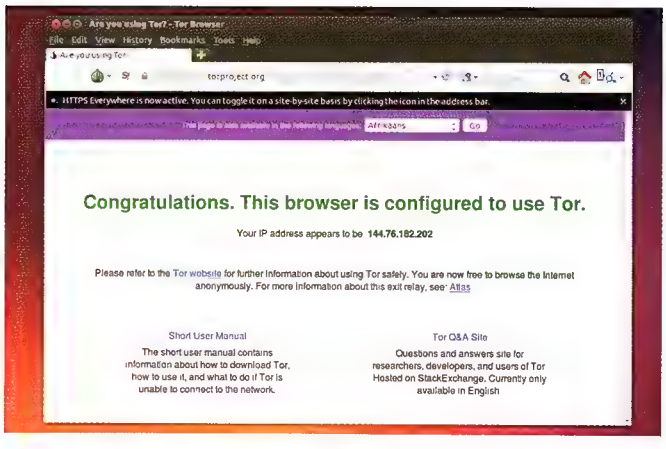
Tor is controlled by the torrc configuration file under the /etc/tor directory. You don't need to modify this file for normal Tor usage, but since we want the Tor installation to accept connections from other computers in the network, we'll have to tweak it. Open the file in any text editor and make sure the SocksListenAddress parameter points to the IP address of this machine (192.168.1.100) instead of the IP address of the localhost (127.0.0.1), such as SocksListenAddress 192.168.1.100.

In the same configuration directory you will also find another file named

Use the Tor Browser Bundle

The easiest way to use Tor.




Are you using Tor? - Tor Browser
torproject.org
HTTPS Everywhere is now active. You can toggle it on a site-by-site basis by clicking the icon in the address bar.
Congratulations. This browser is configured to use Tor.
Your IP address appears to be 144.76.182.202
Please refer to the Tor website for further information about using Tor safely. You are now free to browse the Internet anonymously. For more information about this exit relay, see: Atlas
Short User Manual
The short user manual contains information about how to download Tor, how to use it, and what to do if Tor is unable to connect to the network.
Tor Q&A Site
Questions and answers site for researchers, developers, and users of Tor Hosted on StackExchange. Currently only available in English

1 DOWNLOAD THE BUNDLE

Once you have downloaded the Tor Browser Bundle from **www.torproject.org**, double-click on the executable file, which is a self-extracting archive. There's no installation involved. All you need to do is select a location for the bundle to extract under. This could be a location on your local drive or on an attached USB drive. Make sure you have about 90MB of available disk space.

2 CONNECT TO TOR

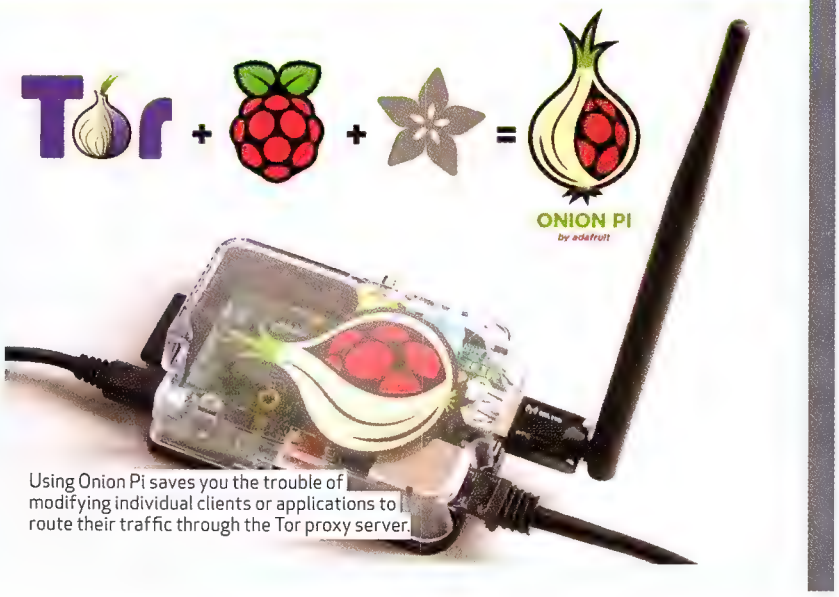
Now fire up a terminal and head to the folder where you have extracted the bundle and run the ./start-tor-browser command. This launches the Vidalia Control Panel, which automatically connects you to the Tor network. As soon as you are connected to the Tor network, Vidalia automatically launches the Tor Browser, which displays your masked IP address.

Turn the Pi into a Tor proxy

Get low-powered and low-cost privacy.

Because you have to keep the anonymous proxy server powered on 24/7, it's best to use the Raspberry Pi. The device has enough resources to do this. If you use the Debian-based Raspbian distro on the RPi, follow the steps in the tutorial as is to install and configure Tor and Vidalia. Furthermore, if you have a Wi-Fi adaptor that's compatible with the RPi, you can use the device to build a Tor-connected hotspot. Once operational, users in your network can detect and connect to this hotspot and all their network traffic is anonymised by the Tor network.

Adafruit explains the steps involved in creating such a Tor-enabled hotspot at http://learn.adafruit.com.



Using Onion Pi saves you the trouble of modifying individual clients or applications to route their traffic through the Tor proxy server.

tor-tsocks.conf. This is the configuration file for tsocks, which allows the use of SOCKS proxies to applications that don't support them.

Again, open this file in any text editor and make sure it points to you local network by adding the following lines:

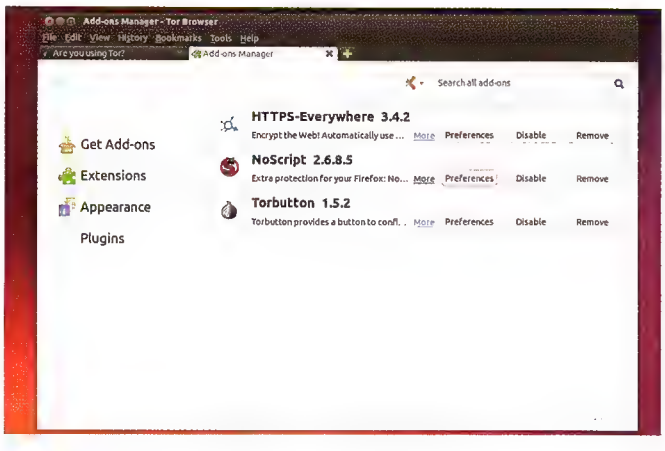
```
server = 192.168.1.100
server_port = 9050
```

That's all there's to it! Your anonymous proxy server is good to go.

USE TOR

To anonymise your network traffic, you have to make sure all your apps connect to the internet via the proxy server you've just set up. You can do this either by asking your operating system to route all network traffic through the Tor proxy server or by configuring individual apps.

> "To anonymise your network traffic, you have to make sure all your apps connect to the internet via the proxy server."


Add-ons Manager - Tor Browser
File Edit View History Bookmarks Tools Help
Are you using Tor?
Add-ons Manager
Search all add-ons
Get Add-ons
Extensions
Appearance
Plugins
HTTPS-Everywhere 3.4.2
Encrypt the Web! Automatically use ... More Preferences Disable Remove
NoScript 2.6.8.5
Extra protection for your Firefox: No... More Preferences Disable Remove
Torbutton 1.5.2
Torbutton provides a button to confi... More Preferences Disable Remove

3 CONFIGURE SECURITY ADD-ONS

The Tor Browser includes a bunch of components that make it different from other browsers. In addition to Tor, the browser ships with some add-ons that help protect your privacy and stay anonymous. Of note are Torbutton to configure Tor, and HTTPS Everywhere to force the use of the secure HTTPS protocol for popular web sites.

Under Ubuntu 13.10, click on the Gears icon in the top-right corner of the screen and head to 'System Settings'. Now head to 'Network settings' under the Hardware section and switch to the 'Network proxy' section. Select Manual from the pull-down list of available methods and fill in the connection details of the anonymising proxy server next to the 'SOCKS Host' field. Finally, click on the 'Apply system wide' button.

If you instead want to tweak individual apps, you need to bring up their configuration dialog boxes and head to their Proxy configuration sections, where you'll point them to the IP address and port of the Tor daemon running on the server.

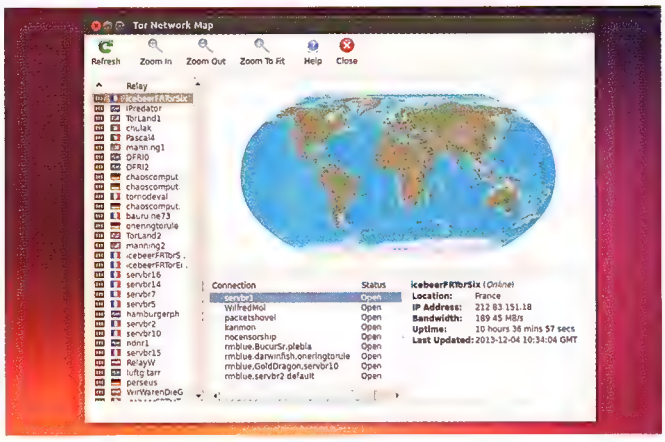
For example, in Firefox head to 'Edit > Preferences' and jump to the Advanced section. Here, switch to the Network tab and click on the 'Settings...' button, which lets you specify proxy settings. Now select the radio button, which lets you specify the configuration manually, and fill in the connection details of the proxy server in the SOCKS Host field, and make sure the 'SOCKS v5' radio button is toggled.

Firefox, in particular, requires another tweak. By default, the app doesn't send DNS queries through the SOCKS5 proxy. To do so, type `about:config` in the address bar and search for the network.proxy.socks_remote_dns variable. To change its value from false to true, right-click on the variable and then select the Toggle option.

Similarly, you can alter the configuration of other network apps that support the SOCKS5 protocol. You can monitor and control the connection to the Tor network using Vidalia.

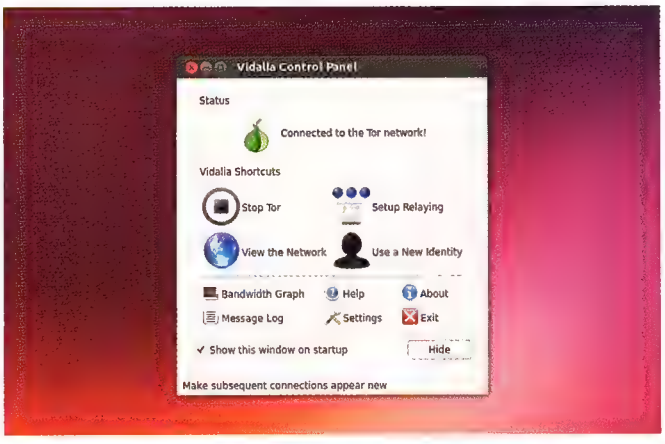
Control Tor

Take control with the Vidalia Control Panel.



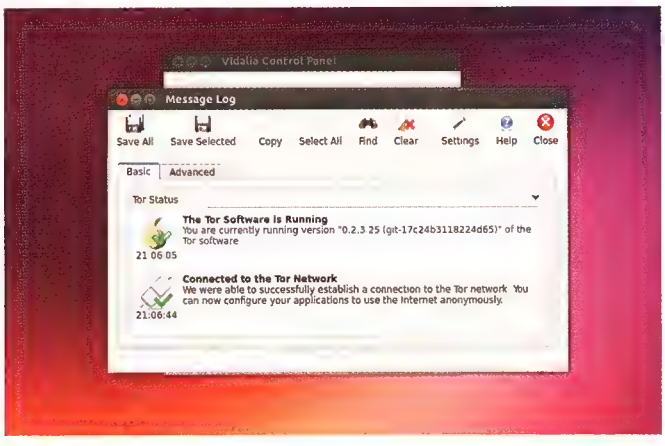
1 VIEW THE NETWORK

The View the Network button brings up a world map showing the locations of the active relays and how your web traffic is routed. The panel on the left lists the currently active relays. The middle box shows the nodes that are routing your traffic. Information about the nodes, such as location, bandwidth and uptime, is listed bottom-right.



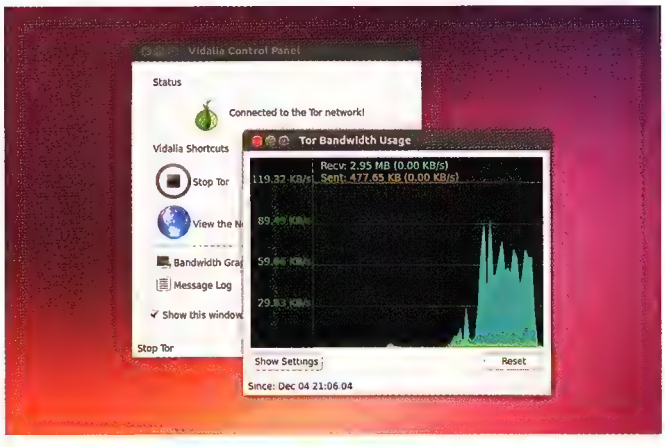
2 GET A NEW IDENTITY

Some web sites block access based on the geographic location of the visitor. Tor circumvents such checks by routing traffic through its relays. If you need to manually generate a new IP address, click 'Use a New Identity'. You could do this when a web site is blocking your existing Tor IP address or you need to visit the site as a different user.



3 VIEW THE MESSAGE LOG

Keep an eye on Tor's log to see if it is working properly. Click on 'Message Log' to display the log, which helps determine the cause of the problem if Tor isn't working properly. Switch to the Advanced tab to get a more detailed view. As per the official Tor documentation, many errors can be resolved by restarting the computer.



4 END SESSION

Besides the slight hit to the browsing speed, and the inability to play Flash-based content, the Tor Browser behaves like any other browser. When you are done, close any open Tor Browser windows — doing so automatically deletes the list of web pages you have visited and also disconnects you from the Tor network.

Tails

The distro for privacy-conscious users

If you like Tor, you'll love Tails Linux. Its goal is to enable you to use the internet anonymously and circumvent censorship without leaving any trace of any internet activity on the computer.

Tails — The Amnesic Incognito Live System — is a Debian-based distro designed to be used from a DVD or a USB stick. Tails runs from the RAM and makes sure it doesn't use the swap partition. It comes with several built-in applications pre-configured with security in mind: web browser, instant messaging client, email client, office suite and more. You can pull additional software using Synaptic from the Debian repos.

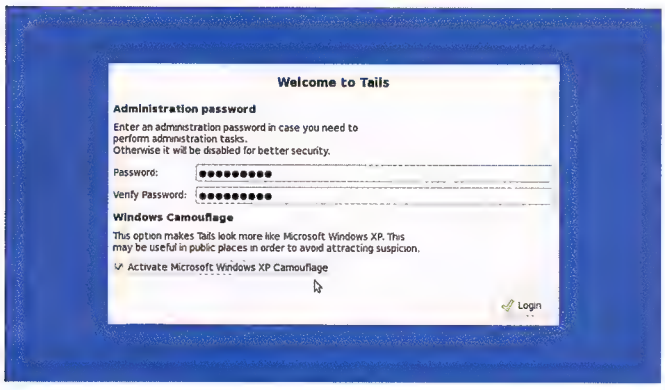
All interactions with the internet pass through Tor, and Tails includes tools to encrypt all other forms of communications.

If you are worried about hardware keyloggers monitoring everything you type, the distro also includes an on-screen keyboard. If you want to use it in a public place such as an internet cafe without arousing suspicion, the distro also includes a camouflage mode, which transforms its Gnome 2 desktop to resemble a Windows XP desktop.

The distro also includes a password manager and tools to encrypt snippets of text that you can then safely pass over unencrypted networks.

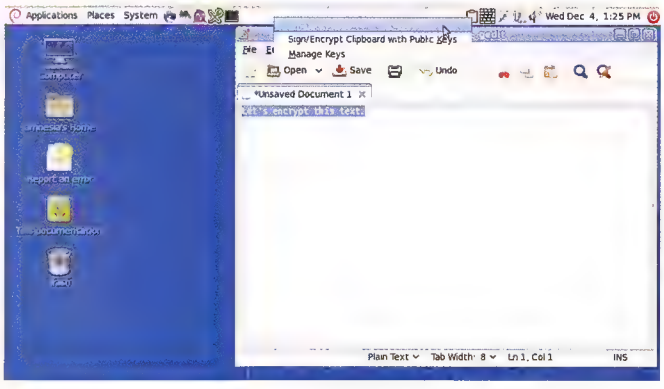
Tails: a live distro with amnesia and privacy

Get comprehensive anonymity with Tails.


Welcome to Tails
Administration password
Enter an administration password in case you need to perform administration tasks.
Otherwise it will be disabled for better security.
Password:
Verify Password:
Windows Camouflage
This option makes Tails look more like Microsoft Windows XP. This may be useful in public places in order to avoid attracting suspicion.
Activate Microsoft Windows XP Camouflage
Login

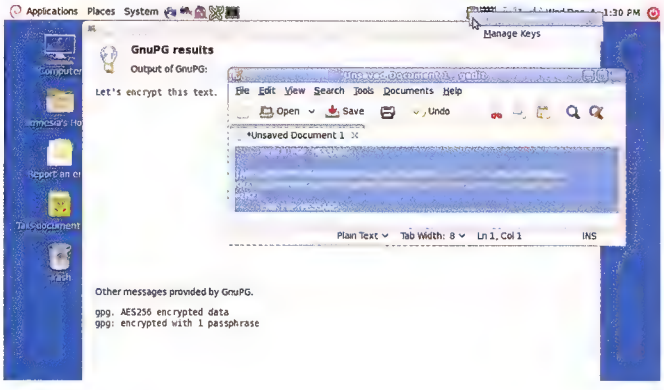
1 SET-UP OPTIONS

Download the Tails Live distro from **tails.boum.org** and transfer it to DVD or USB disk. When you boot the distro, it gives you the option to set additional configuration parameters. If you do, the distro prompts you to enter a password for the system administrator, as well as change the distro's appearance to resemble Windows XP.


Applications Places System
Sign/Encrypt Clipboard with Public Keys
Manage Keys
Open Save Undo
*Unsaved Document 1
Let's encrypt this text.
Plain Text Tab Width: 8 Ln 1, Col 1 INS

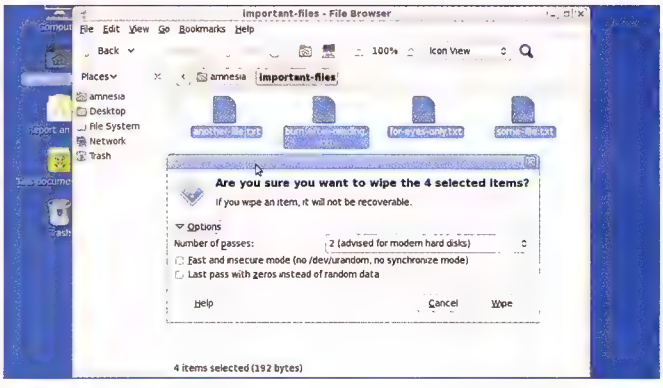
2 ENCRYPT TEXT WITH PASSPHRASE

You can easily encrypt your communications using the OpenPGP encryption applet. Select the text you want to encrypt and copy it to the clipboard by pressing Ctrl-C. Then click on the applet and select 'Encrypt Clipboard with Passphrase'. Enter the passphrase when prompted and press Ctrl-V to paste the encrypted text.


Applications Places System
GnuPG results
Output of GnuPG:
Let's encrypt this text.
Manage Keys
Open Save Undo
*Unsaved Document 1
Plain Text Tab Width: 8 Ln 1, Col 1 INS
Other messages provided by GnuPG.
gpg: AES256 encrypted data
gpg: encrypted with 1 passphrase

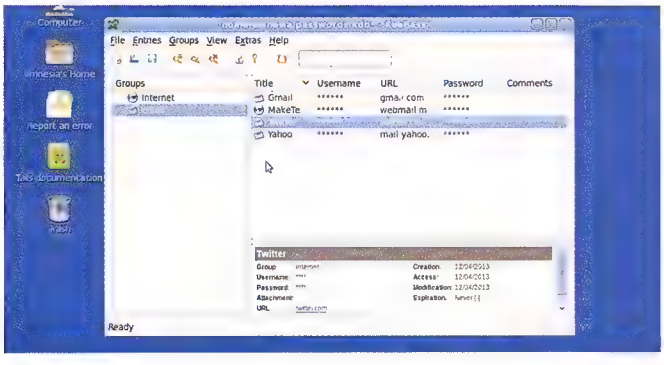
3 DECRYPT TEXT

You can store this encrypted version of the text on your computer or pass it to someone else over unencrypted networks. To decrypt the text, select the encrypted text and copy it to the clipboard with Ctrl-C. Now click the applet and select 'Decrypt/Verify Clipboard'. Enter the passphrase when prompted to view the decrypted text.


important-files - File Browser
Are you sure you want to wipe the 4 selected items?
If you wipe an item, it will not be recoverable.
Options
Number of passes:
2 (advised for modern hard disks)
Fast and insecure mode (no /dev/urandom, no synchronize mode)
Last pass with zeros instead of random data
Help Cancel Wipe
4 items selected (192 bytes)

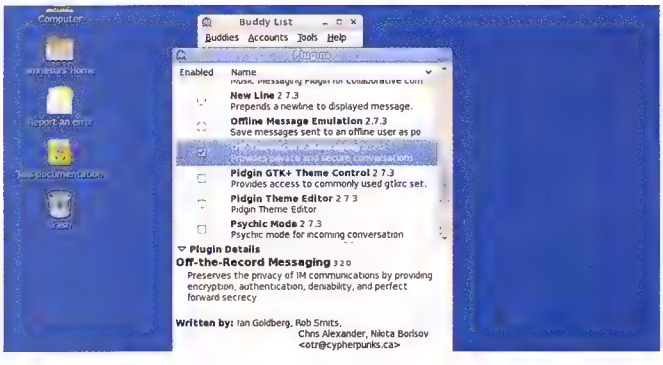
4 SECURELY DELETE FILES

Deleted files aren't zapped out of existence when you delete them; it doesn't take much effort to recover deleted files using tools such as PhotoRec, but Tails lets you securely delete files with an extension of the Nautilus file manager, called Nautilus Wipe. Select the files to delete in Nautilus and select Wipe from the right-click context menu.



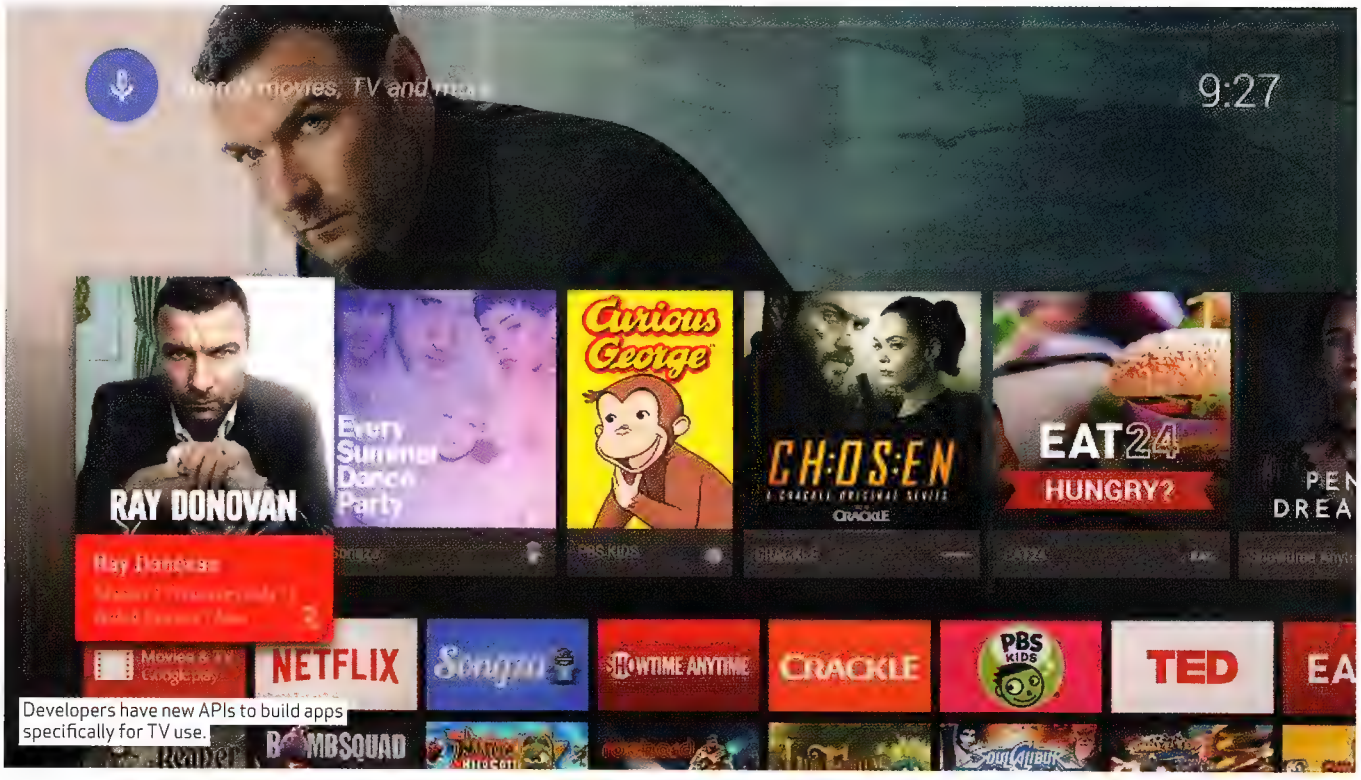
5 MANAGE PASSWORDS

Tails includes the KeePassX password manager. With it you can store passwords in an encrypted database, but you should only use it when using a persistent volume. Head to 'Application > Tails > Configure Persistent Volume' to create a persistent volume. Launch KeePassX, create a new database and save it on the persistent volume.


Buddy List
Buddies Accounts Tools Help
Plugins
Enabled Name
New Line 2.7.3
Prepends a newline to displayed message.
Offline Message Emulation 2.7.3
Save messages sent to an offline user as po
Pidgin GTK+ Theme Control 2.7.3
Provides access to commonly used gtkrc set.
Pidgin Theme Editor 2.7.3
Pidgin Theme Editor
Psychic Mode 2.7.3
Psychic mode for incoming conversation
Plugin Details
Off-the-Record Messaging 3.2.0
Preserves the privacy of IM communications by providing encryption, authentication, deniability, and perfect forward secrecy
Written by: Ian Goldberg, Rob Smits, Chris Alexander, Nikita Borisov <otr@cypherpunks.ca>

6 STAY ANONYMOUS ONLINE

To anonymise your web browsing and other internet activities, Tails includes the Torbutton and other extensions in the IceWeasel web browser, as well as Vidalia to control the Tor network. The distro also includes the Pidgin chat client, along with the Off-the-Record plug-in, which is enabled by default, to encrypt all communications.



Developers have new APIs to build apps specifically for TV use.

Google preps new Android L

The search giant has a new version of Android on the way with plenty of new toys. Darren Yates looks at what lies ahead.

Google I/O is the most important conference of the year for Android fans and developers alike. Similar to Apple's Worldwide Developers Conference, I/O is your best bet for finding out what Google has coming around the corner. And while the company already has plenty of irons in the fire with driverless cars and cardboard virtual reality frames, the most relevant to us at Android Masterclass HQ is the impending arrival of Android 'L'. Just what the 'L' stands for has most people guessing 'lollipop', but 'L' also happens to be the Roman numeral for '50' (as in 'Android 5.0'), so we'll go with that, just to be different. Whatever the case, Android L looks set to herald in one of the most significant round of changes since the arrival of Ice Cream Sandwich. And if you're game and have the right device, it's already here (well, sort of).

BIG CHANGES ON THE WAY

What made the arrival of Android 4.0 so momentous was the unification of the-then disparate smartphone (Gingerbread/2.3) and tablet (Honeycomb/3.2) OS streams into a single platform. Now, it looks as though Android L will do the same again, this time, creating a unified experience for phone and tablet, along with TV and wearable devices.

It's pretty fair to say that Google TV wasn't the roaring success its makers had hoped for, but with a string of announcements for 'Android TV', Google is set to have another crack at it with another household brand-name. The rapid rise of wearable tech has also been too hard to ignore.

ANDROID 4.4W

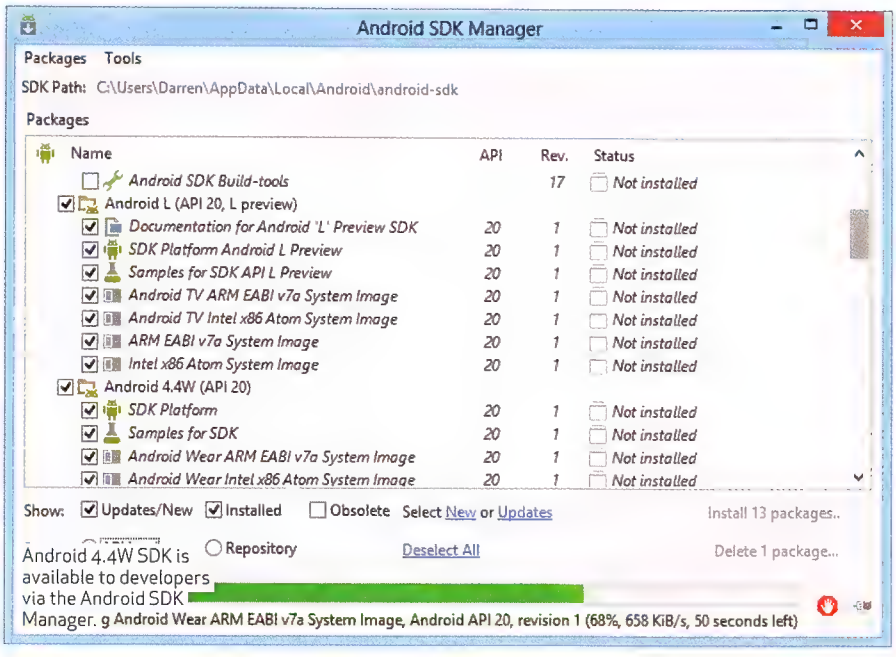
In fact, so important has wearable tech become that Google isn't waiting for Android L to get developers on-board, releasing a new SDK (software development kit) called Android 4.4W. It's designed specifically for Android Wear, Google's new wearable platform, which so far is set to appear as the LG G Watch, Samsung Gear Live and Motorola's Moto 360. Developers can get the SDK now – it's available for download through your RAD/IDE's Android SDK Manager.

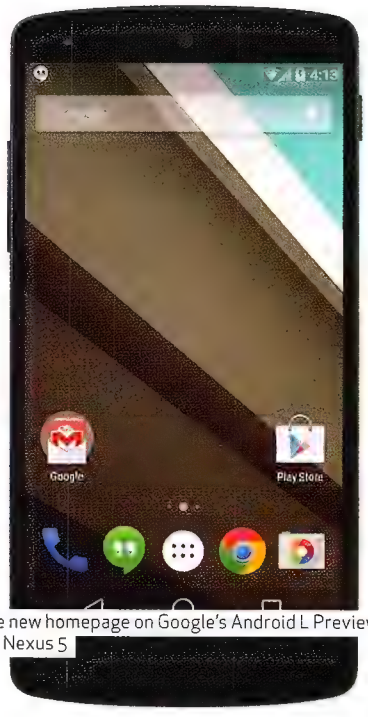
The one surprise we've spotted so far in 4.4W is support for Intel x86 Atom processors. Intel hasn't always been known for scintillating power management when it comes to phones and tablets, but the latest Bay Trail-class Atom multi-core CPUs are kicking quite a few goals and appearing in plenty of devices at the moment. That said, we weren't expecting the idea of Intel-powered watches. Still, there's no guarantee we'll see any in Australia, but at least lack of development APIs (application prog84ramming interfaces) won't be an impediment.

But it's not just Intel – Android Wear has some major mobile chip brands on board, including Broadcom (CPU maker for the low-cost Raspberry Pi single-

Preview Android L on your Nexus device

If you're the adventurous type, know how to back up your device and flash a new ROM, you can grab a preview of the new Android L OS for Nexus 5 phones and Nexus 7 tablets. Be warned though — Google is up-front about this not being a stable release and may cause your device to stop working. The installation process is also quite complex and requires a dozen or so steps (one such guide with links to the OS archives can be seen at **tinyurl.com/mpmf778**). Newbies need not apply.


Android SDK Manager
Packages Tools
SDK Path: C:\Users\Darren\AppData\Local\Android\android-sdk
Packages
Name API Rev. Status
Android SDK Build-tools 17 Not installed
Android L (API 20, L preview)
Documentation for Android 'L' Preview SDK 20 1 Not installed
SDK Platform Android L Preview 20 1 Not installed
Samples for SDK API L Preview 20 1 Not installed
Android TV ARM EABI v7a System Image 20 1 Not installed
Android TV Intel x86 Atom System Image 20 1 Not installed
ARM EABI v7a System Image 20 1 Not installed
Intel x86 Atom System Image 20 1 Not installed
Android 4.4W (API 20)
SDK Platform 20 1 Not installed
Samples for SDK 20 1 Not installed
Android Wear ARM EABI v7a System Image 20 1 Not installed
Android Wear Intel x86 Atom System Image 20 1 Not installed
Show: Updates/New Installed Obsolete Select New or Updates
Install 13 packages..
Repository
Deselect All
Delete 1 package...
Android 4.4W SDK is available to developers via the Android SDK Manager. g Android Wear ARM EABI v7a System Image, Android API 20, revision 1 (68%, 658 KiB/s, 50 seconds left)



The new homepage on Google's Android L Preview for Nexus 5

board computer), MediaTek and Qualcomm, all of which create chips based on Intel-rival ARM Cortex A-series CPU designs. And with the big guns like LG, ASUS, Samsung, HTC and Motorola all signed up, expect to see Wear go beyond the standard smartwatch. Add to that news of watchmaker Fossil launching an Android Wear smartwatch later this year, plus the rumours of traditional watch designers being poached by a cashed-up Apple and you could be forgiven for thinking tech is about to go all 'haute couture' on us!

PROJECT VOLTA

Meanwhile, back at Android L, power management has long been a bugbear for all portable-powered devices and Google thinks it has its best chance yet to nail down the issue with what it's calling 'Project Volta'. Google likes to take a particular area of mobile design and focus hard on improvements in that area for a major OS release – think 'Project Butter' for Jelly Bean/4.1 for example, the effort to improve overall UI smoothness by boosting the frame rate.

There are generally two ways you can improve any aspect of user experience in an operating system – you can bake improvements into the OS, so that they're automatically apparent and generally available to any app; the other is to provide developers with extra 'keys' to unlock new OS features in new apps. Project Volta does both.

BATTERY STATISTICS

Android already has the ability to track battery usage and the current battery capacity remaining (the dozens of battery apps on Google Play attest to this). But Android L will come with tools and new APIs to mine a greater depth of information about that usage, including the new 'batterystats' tool that drills down into the software component level for battery usage information. It'll also come with a new 'Battery Historian' tool allowing developers to see a graphical representation of that usage and get a feel for it in an instant.

Get more info

The best place to find more information behind the changes in Android L is Google's Developer web site at **developer.android.com/preview**.

BATTERY SAVER FEATURE

From the user side, there's a new 'Battery Saver' feature inside Android L that doesn't require any app modifications or new development.

Google's ADT-1 Developers Kit for Android TV looks like fun...

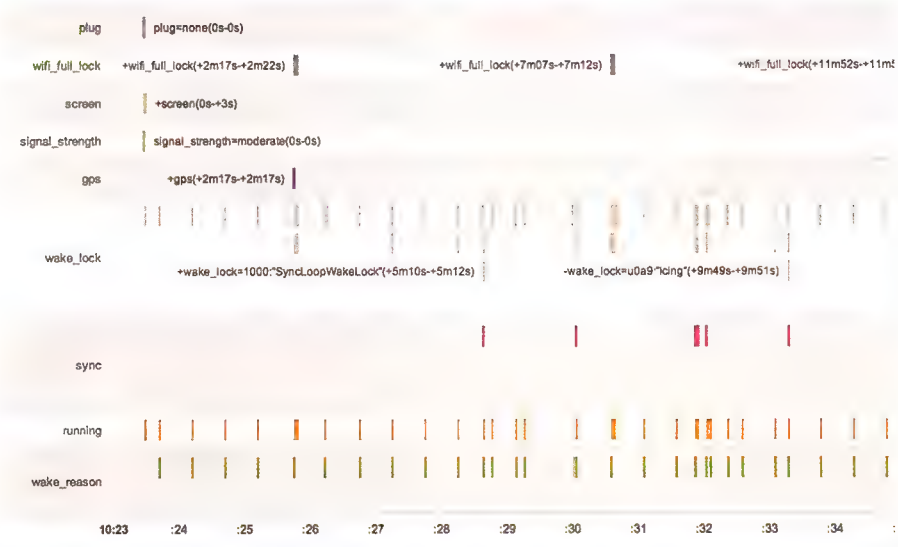
It's located in the Settings menu under 'Battery'. Once the battery capacity remaining dips below a default 15%, the OS will automatically reduce overall device performance to compensate and squeeze out more runtime. You'll also be able to set the 'trigger' value to between 5% and 20% of capacity remaining in 5% increments, or simply turn it off.

Is it new? No, ideas similar to this have been floating around in recent custom ROMs from Samsung and the like. Battery maintenance apps going back to JuiceDefender have had similar battery-level triggered options as well. We suspect Battery Saver will work along the same lines as CPU underclocking apps normally requiring root access. What makes this different is it's the first time Google has incorporated the concept into its OS.

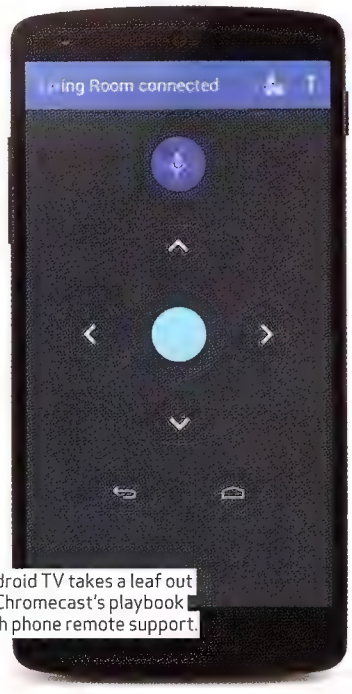
RESULTS

Android L is available to developers as a 'preview' release for a limited number of Nexus devices and already, there's enough evidence suggesting Volta will make a significant improvement to battery life. According to Ars Technica (**tinyurl.com/ms5rh96**), jumping from KitKat/4.4.4 to L Preview on a Nexus 5 smartphone resulted in a rise in battery life from 345 to 471 minutes – a two-hour or 30% gain.

However, it'll be interesting to see how the final Android L release performs against pre-L devices tweaked up with already available battery apps. Clearly, some of the more L-specific features won't be replicable, but the Android L gains may not be as high for devices already using power-saving tweaks, compared with those operating stock 'L' ROMs.



Android L's Battery Monitor helps developers locate app battery usage.



Android TV takes a leaf out of Chromecast's playbook with phone remote support.

> "It means apps will be able to postpone more power-hungry functions until there's a whiff of AC mains power."

NEW SCHEDULER

There are also new toys for developers to help improve how their apps perform on battery power, including a new API called android.app.job.JobScheduler that allows apps to schedule functions to run at a different time ('asynchronously'). Google gives a few scenarios for this, including waiting to run a task until the device is plugged into mains power. Another API called android.app.job.JobInfo.Builder provides the tools to schedule the task, based on power and other constraints. It means apps will be able to postpone more power-hungry functions until there's a whiff of AC mains power, rather than sucking the battery dry. It's a great feature and hopefully will lead to more 'power aware' apps in the future.

ART FINALISED

ART is Google's new Android RunTime coding engine, first previewed as an option in KitKat/4.4 where Dalvik maintained pole position as default choice. Now Android L is expected to turn the tables and offer ART as the default engine. The old Dalvik engine compiled an app's Java bytecode 'just in time' (JIT) for processing, but ART does the precompile once on installation. This means your device has CPU-specific code ready to run, so it's more efficient on CPU requirements and battery. Dalvik was the right engine for a time when RAM, CPU speed and storage weren't in abundant supply, something that is no longer the case now. ART is also 64-bit, so it'll be able to make use of Intel Atom and upcoming ARM Cortex A-series CPUs for more efficient processing.

However, Google continues to mention that there are likely compatibility issues with apps using the Java Native Interface (JNI) to run high-performance C++ code. For now, however, it's saying 'most Android apps should just work without change under ART'.

BLUETOOTH LE FEATURES

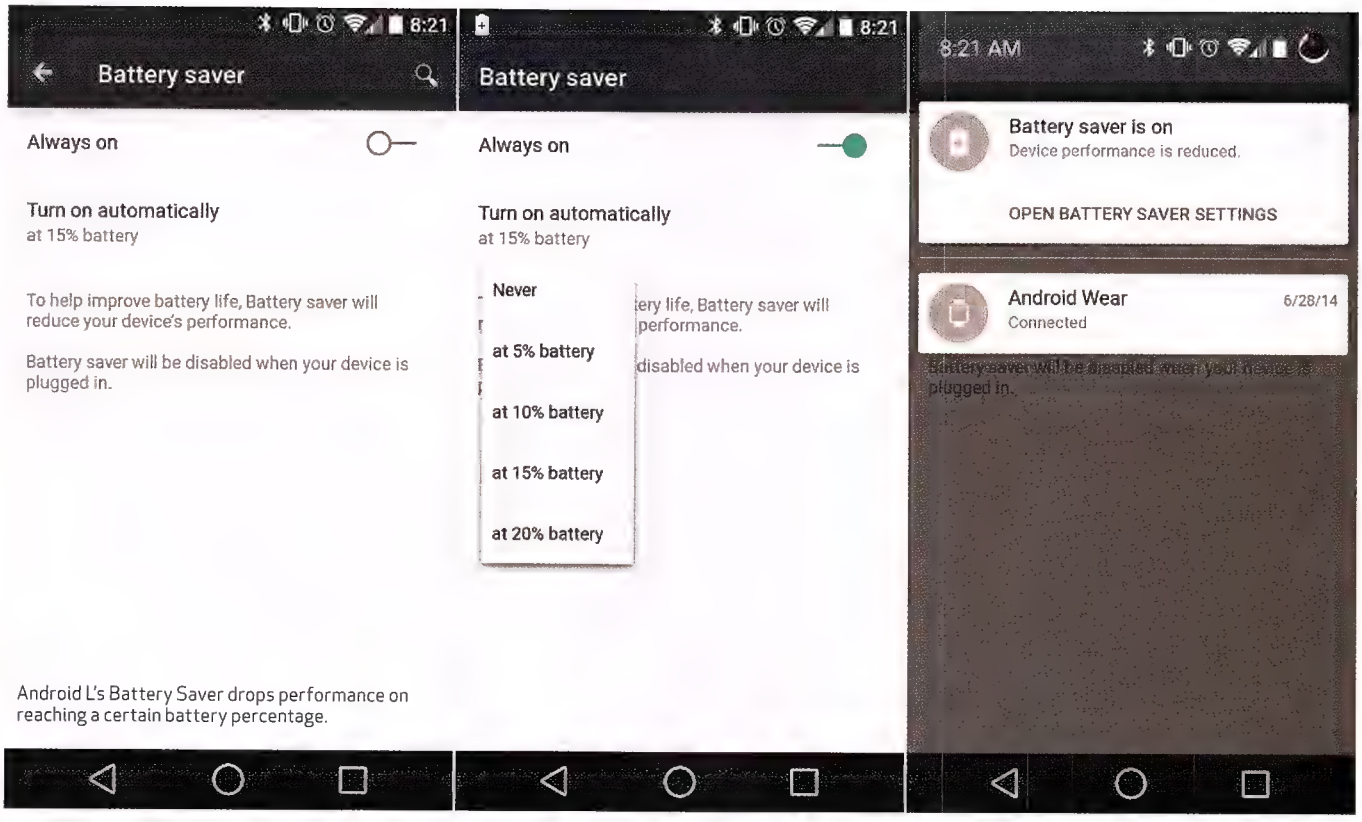
If you thought Bluetooth was already a low-power wireless connectivity standard, Bluetooth Low Energy (BLE) takes things a step further. Android L will continue adding new features to its BLE support that began back in Jelly Bean/4.3 – this time around, allowing developers to make an Android device act as a BLE peripheral device and indicate its presence to other BLE-ready Android devices.

In plain English, developers can take the functionality of screen-less smartband-style devices and turn it into an app – for example, an app can allow an Android device to function as a health monitor, wirelessly streaming its data to another BLE-ready device.

LG's new G Watch is one of the first Android Wear devices to land.

Experienced users can trial the Android L preview on the Nexus 7 tablet.

Android-powered mini TV PCs like this MK908 sell for under $50 on eBay.



Android L's Battery Saver drops performance on reaching a certain battery percentage.

Again, BLE is yet another strategy to help reduce overall power consumption in mobile devices.

NEW MULTIMEDIA APIS

There are several new toys for multimedia apps too, including a new advanced camera API Google says is to 'facilitate fine-grain photo capture and image processing'. Apps will now be able to better access on-board camera facilities and be notified when a new image is available. Throw in support for floating-point audio samples to give greater dynamic range, plus a new media controller API and we should start seeing more richly-featured photo and media player apps in the not too distant future.

ANDROID TV

Google had high hopes for its eponymously-named TV system when it launched back in 2010. That it failed to take hold in a notoriously fickle market hasn't dampened the company's enthusiasm for the concept, launching its sequel as 'Android TV' (**developer.android.com/preview/tv**). But, to be fair, there are considerable changes this time around, not least of which is its inclusion in the mainstream Android OS, rather than as a completely separate product stream. Still, it's no guarantee of success.

When Google TV initially arrived in Australia, it was tied to the purchase of a Sony Bravia TV. By the time it went on sale as a standalone unit, its $350 price tag was always going to be a struggle, particularly given TV stick/mini PCs were then available, delivering a full Android experience in a plug-in device for as little as $40, long before any of us had heard the word 'Chromecast'. There are dozens of these mini PCs now available online, mostly dual and quad-core CPU based models selling for well under $100.

The new ADT-1 Developer Kit with its bundled gamepad gives a clear indication on the direction this version of Google's TV franchise is headed. Google has a small number of these kits that offers Ethernet, Wi-Fi and Bluetooth connectivity, along with Chromecast-like ability to stream media and control it via your smartphone or the gamepad (You can try the remote app now on certain devices from Google Play. Just search 'Android TV Remote Control'.)

By bundling it into Android L, we think Google is at least giving Android TV a better start, with developers already able to create more unified apps, thanks to the API being readily available (even if only as a 'preview' for now).

WHICH DEVICES WILL GET IT?

While there'll clearly be a steady stream of new devices rolling out once the OS is generally available (likely by November this year), the question is which existing devices will be given the 'L' update? So far, Motorola has announced the Moto X is a definite starter, so too is HTC's One M7 and M8. HTC has gone further, saying it will roll out updates within 90 days of Android L's launch. At time of writing, Samsung, Sony and LG had yet to declare their intentions, but it's likely the Galaxy S4 and S5 will nab updates, so too the Xperia Z1 and Z2 tablets and phones, plus LG's G3 and possibly the G2 phones.

Beyond that, we wouldn't hold our breath if your device is 18 months or older by the time of Android L's launch.

Motorola's current Moto X flagship phone will get an Android L update.

BRING IT ON

Bringing its two separate streams together in Ice Cream Sandwich saw the Android platform take off. By combining everything from phone to TV, wearables to tablets in Android L, plus a healthy dose of improved power management, it should launch the platform to a new level. We'll soon see.

Jaycar Electronics

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Your One-Stop-Shop for Arduino compatible products & accessories.

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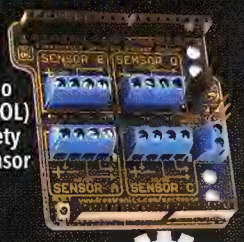
SECURITY SENSOR SHIELD



Allows up to 4 security sensors to be simultaneously connected to an Arduino with full End-Of-Line (EOL) support. Detects a variety of events including sensor triggered, housing opened, cable cut and short-circuited.

- Status LEDs on each channel
- No surface mount assembly required

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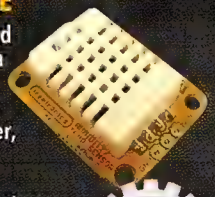

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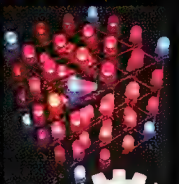

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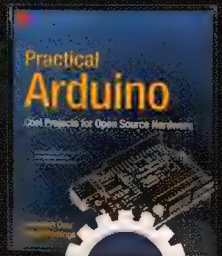

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Project #21 – Sports Timekeeper

Darren Yates answers a reader request and designs a big-screen timekeeper using an Arduino microcontroller.

About a month or so ago, we received a request from *APC* reader Don Fraser for a special-design count-down timer using an Arduino Uno and a Freetronics 32x16-LED dot-matrix display (DMD). After looking at the idea, I realised this could be made into a project to suit a wider audience and still meet Don's requirements. It also turned out to be an ideal project for looking at how the design process works when you're making your own gear.

KEEPING TIME

The Sports Timekeeper counts down from anywhere between one and 99 minutes, selectable in one-minute increments and will sound a siren (or in our case, a piezo buzzer) as the time period ends. It shows minutes and seconds on the display and you can pause and restart the clock with the same button (such as for 'time off' in a footy match).

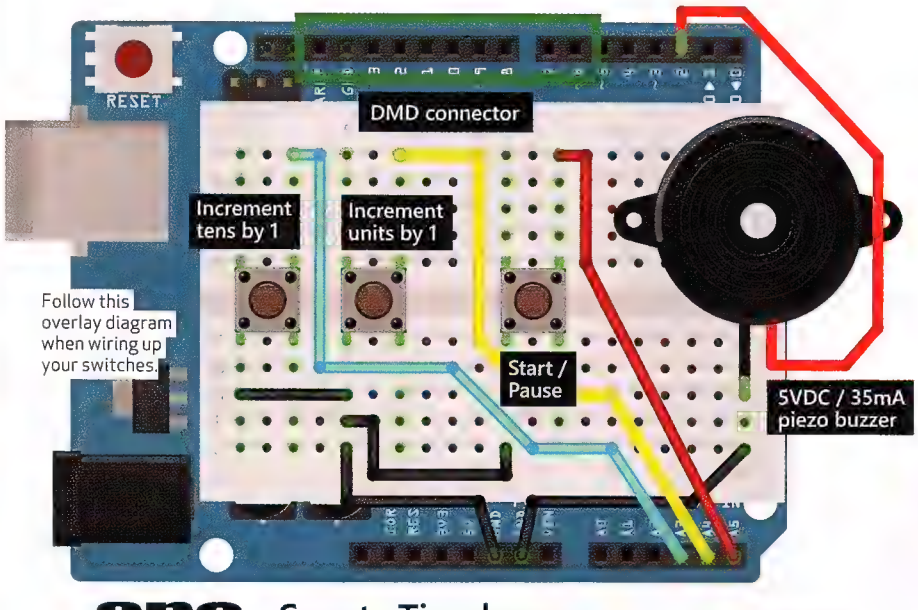
We've kept the design really simple but you could easily expand it if you have some basic knowledge of electronics. All you need for this simple build is:

- Arduino Uno R2 or R3 microcontroller board
- DIY prototyping shield
- Freetronics 32x16-LED dot matrix display
- Three momentary-on pushbuttons
- 5VDC piezo buzzer
- A dozen dupont wires
- And lastly, our source code/sketch software available free from our Arduino webpage at: **www.apcmag.com/arduino.htm**.

HOW IT WORKS

The key component is that 320 x 160mm-sized 32x16-LED Dot Matrix Display (DMD) from local Australian retailer Freetronics (**www.freetronics.com**). We introduced it into our masterclass series not long ago with the Audio Spectrum Analyser project, but it's such a versatile display, you could use it for 1,001 different ideas.

With 512 LEDs to control, you'd be forgiven for wondering how we drive it with an Arduino having just 21 I/O ports. The simple answer is we don't have to worry about that – the DMD only requires six digital I/O pins from the Arduino and uses a technique called 'multiplexing' to control them.



apc Sports Timekeeper Overlay Diagram

Installing the sketch

Get the code

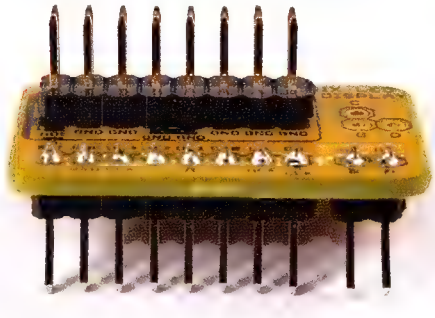
Grab the sketch/source code for this project free from our Arduino webpage at **www.apcmag.com/arduino.htm**. Unzip the file and copy the contents of the /libraries subfolder to the same of your Arduino IDE. Launch the IDE, load the sportstimer.ino file, compile it and flash it to your Arduino Uno board. While the source code has been tested, it comes 'as is' with no warranty — use it at your own risk.

We'll look more at the software driving it shortly.

SWITCHED ON

In the meantime, we need to figure out some way to set the initial time it'll begin to count down from, as well as some way to start, stop or pause the timer. For this project, we thought rather than go the whole hog like we did with the Arduino Enigma Cipher Machine and build the finished product, we'd go for a basic working mock-up via a breadboard instead, just so you can see how the whole thing works. And for that, we've used the DIY prototyping shield with a tiny breadboard on top.

Thanks to the relative ease of programming microcontrollers like the Atmel ATMEGA328P we're using here, there's a tendency these days for



The interface connector between the DMD and your Arduino Uno board.

"We've kept the design really simple but you could easily expand it if you have some basic knowledge of electronics."

designs to go overboard with features. In fact, the end result can be so overloaded with buttons and options that it takes a 50-page manual to work out how to drive the thing! That's why it's so important to work out what your project design is meant to do right at the start, long before you lift a screwdriver. Once you start building, stick to the design like glue and be aware of 'feature creep'.

One thing that can help is remembering who your device is intended for – always err on the side of simplicity with controls and ask yourself do you really need that many buttons or controls.

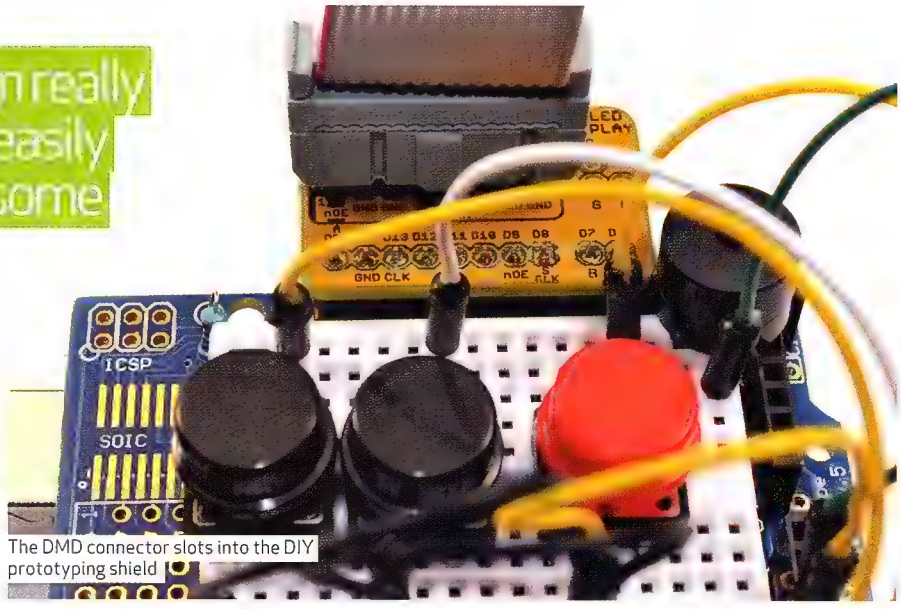
That's why our Sports Timekeeper has just three buttons – two black ones and a red one. The two black ones set up the initial time in minutes – the left increments the count by 10, the right by one. Once a digit reaches '9', the next press loops it around to '0' again.

A typical design for doing this would give each digit separate 'up' and 'down' buttons/switches, but our method saves those two extra switches. At 20c each wholesale, a 40-cent saving is nothing, but if you're planning to make 50,000 widgets, that saving alone puts $20,000 back in your pocket.

The red button is the start/pause button – press it to start the count down, press it again to pause it ('time off') and press it yet again to restart it. Once the timer is started, you can't change the initial time settings, but just put it in pause mode and you can 'change away'. The Sports Timekeeper will simply count down from whatever is displayed on the DMD once it's restarted.

We've added a tiny 5VDC piezo buzzer so that when the timer hits zero, it will sound off continuously in addition to putting up the 'FULL TIME' sign, until the reset button on the DIY proto shield is pressed. Finally, the DMD connector slots into the Arduino via the pin header on the DIY proto shield itself.

Because the DMD uses high-brightness LEDs, you can get a decent brightness level with just the power connected to the Arduino. But for a seriously bright output, you can connect a power supply direct to the DMD, but it needs to be capable of up to 30-amps(!)



The DMD connector slots into the DIY prototyping shield

The Start/Pause button begins the Sports Timekeeper countdown.

Zero triggers the 'full time' sign and output D2 to sound a buzzer.

HOW THE CODE WORKS

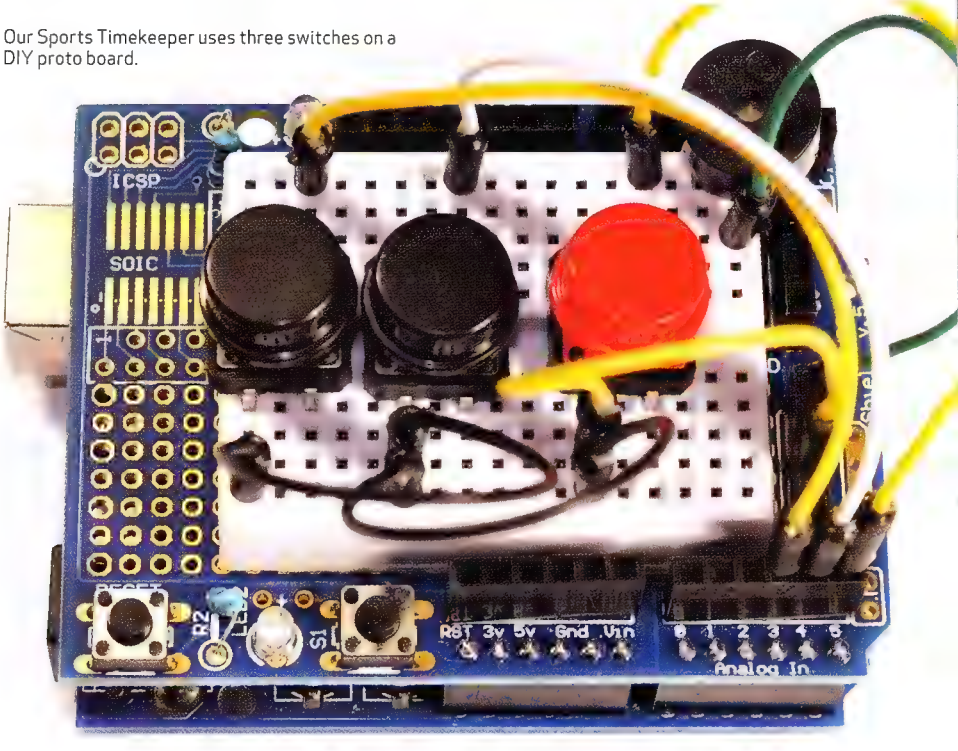
Because the hardware isn't as complex this month, we've got the opportunity to spend more time on how the code works and there are some tricks here worth knowing.

The complex task of controlling the DMD is thankfully handled by the free DMD library, reducing it to little more than print commands to display text, but we still have to create the timing code and handle the input from the momentary switches.

SWITCH DEBOUNCING

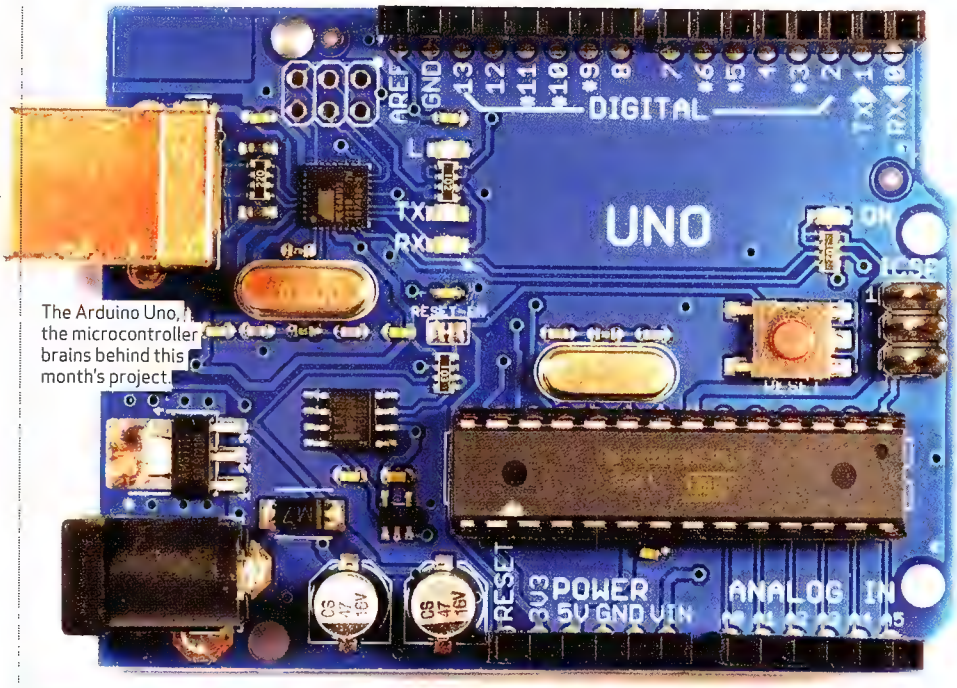
First up, let's tackle the common problem of what's called switch

Our Sports Timekeeper uses three switches on a DIY proto board.

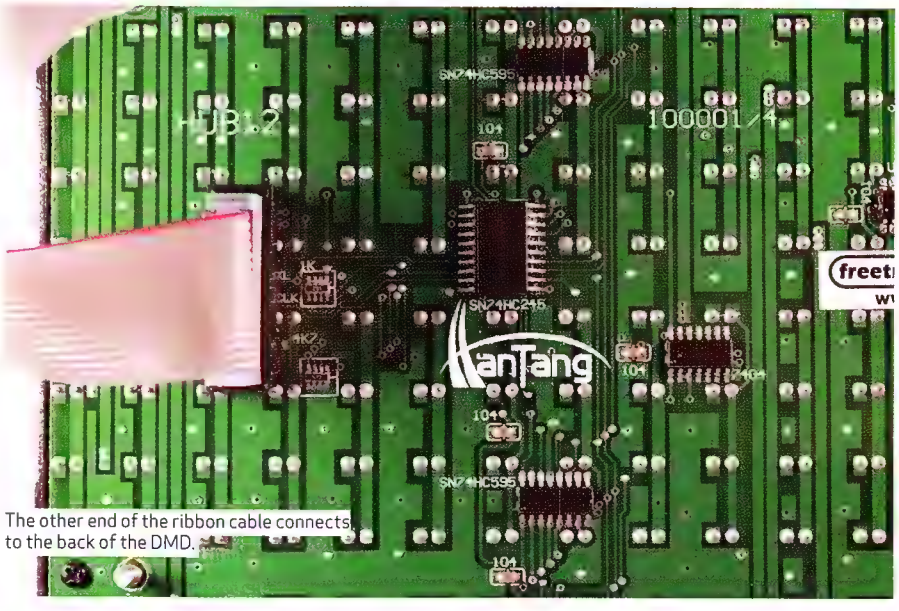


'contact bouncing'. When you press a mechanical switch, you don't just get a single instantaneous change from one voltage level to another. If you were to watch what the switch does via a cathode ray oscilloscope (CRO), you'd see dozens of 'ups and downs' or noise pulses for a few tenths of a second until the switch stops 'bouncing' and it settles into its new 'pressed' state. Now if we just set our code to react to any change in voltage level, the code would trigger on each one of those pulses and we'd end up counting dozens instead of just one.

'Debouncing a switch' just means providing electronic circuitry or code to recognise the first 'leading edge' change only and ignore the rest while it steadies up. There are lots of complicated ways you can do this in software, depending on how tight a time tolerance you need in your code. But we've used a very simple, very crude but very effective solution here – and that's to simply set off a 200-millisecond delay once a level change is detected. That 200 milliseconds gives the switch sufficient time to stop bouncing without noticeably affecting other code. It also provides an added feature – hold the button down and that digit will increment at around five counts per second. (As an experiment, try changing the number in the delay(200) commands inside the loop() method of our sketch code and see what happens!)



The Arduino Uno, the microcontroller brains behind this month's project.



The other end of the ribbon cable connects to the back of the DMD.

HOW LONG IS ONE SECOND?

You set the time of our Sports Timekeeper in minutes, but it displays the count down in seconds – so here's a question: just how long is one second? Unfortunately, an Arduino doesn't come with an in-built clock we can watch Mickey's second-hand tick around on. But what it does have, however, is a crystal-locked 16MHz clock signal driving the microcontroller, creating a new clock pulse every 62.5nanoseconds. It also has three timers on-board – not timers in the usual sense, but binary counters that can be clocked by at a fraction or 'prescaler' of that 16MHz clock signal. You might remember we used one of these timers in our Digital Audio Recorder project a few months ago. We can do something similar here – use a timer to launch a trigger or 'interrupt' at a precise time interval (let's say 1000 milliseconds) to decrement our count and update the DMD.

And that's exactly what we do here – except, we're cheating and using the free TimedAction library to do the hard yakka for us, but this is essentially how the library works. In the end, the Arduino triggers an interrupt after each second, which is then directed to launch the clockUpdate method in our code that decrements the count and updates the display.

MONITORING THE SWITCHES

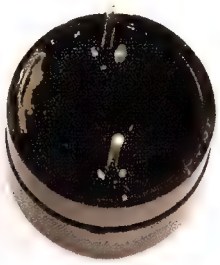
While the code is continually waiting for each second and the interrupt that triggers our decrementing code, we also need to keep an eye on the start/stop button, so we can pause or restart the count on the user's command.

Use the two black buttons to set the time in minutes at start or in pause.

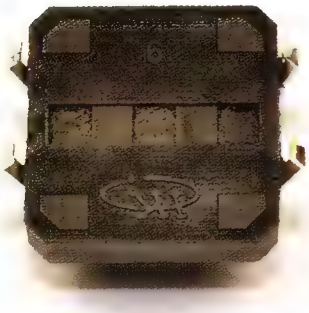
This appears for three seconds before reverting to time when you pause.

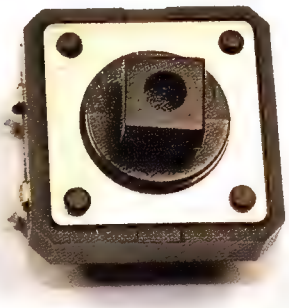
As soon as you power up, the Sports Timekeeper is ready to set the timer.

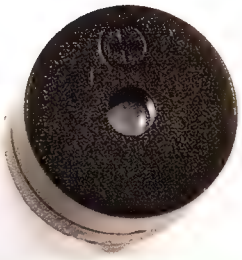
These cheap PCB momentary-on switches are everywhere on eBay.



This tiny 5VDC buzzer packs a punch and runs via an Arduino port directly.







When writing Arduino code, there are only two methods you need to include – setup() and loop(). Setup() runs once at the start and loop() loops continually until the power is removed or the reset button is pressed. That loop() method provides us with the coding window we need to monitor the button switches.

Those switches are connected to three of the Arduino's analog ports, A3, A4 and A5, all configured as digital inputs and using the built-in pull-up resistors. The switches we're using are basic momentary-on pushbutton switches – essentially, they act as though you're just joining two wires together. The pull-up resistors are activated by the pinMode command:

```
pinMode(A5, INPUT_PULLUP);
```

and ensure that the corresponding Arduino input sees 5VDC (a digital 'high') when the button isn't pressed (that is, it's 'open'), but is pulled to ground (digital 'low') when it is pressed (the switch is 'closed'). Using the Arduino's internal resistors also mean we don't have to supply our own, saving more money in our design. Again, these are cost-savings you would need to consider when designing real products.

The loop() method contains two main code threads – one that monitors whether or not the clock timer is paused, in which case, it keeps an eye on inputs A3 and A4 (the initial time set buttons), and another thread that monitors input A5 (the start/stop button).

DMD CODE

The Freetronics' 32x16-LED DMD comes with free Arduino code libraries that make it extremely easy to write text on the display. To start, you 'initialise' the library by creating a new DMD 'object' we're calling 'dmd' (lowercase). After creating a second timer called 'Timer1' using the TimerOne library and attaching it to our dmd object, we then call the 'dmd.clearScreen(true)' command to blank the display and 'dmd.selectFont' to choose one of three display fonts included in the code library.

> "Remember to beware of feature creep, otherwise, you may never get it finished!"

We write text to the DMD using the 'dmd.drawString(x,y, string, string_length, display_code)' command. The 'x' and 'y' refer to the pixel coordinates (x,y) of the DMD where the first letter will begin, with top-left being (0,0). The 'string' refers to the text you want displayed, while 'string_length' is an integer representing the number of characters in the string. The 'display_code' allows you to change how the display works, such as display rotation.

For example, our 'FULL TIME' sign requires two commands:

```
  dmd.drawString(5,0,"FULL",4,G
RAPHICS_NORMAL);
  dmd.drawString(5,8,"TIME",4,G
RAPHICS_NORMAL);
```

We start at the sixth pixel across on the first row (co-ordinates are zero-based), draw 'FULL', move to the same pixel across but down to the ninth row and draw 'TIME'. To be honest, we're not sure why the 'string_length' parameter exists in this command since it can be calculated from the string itself.

EXTRA CODE LIBRARIES

While our sketch/source code may not have many lines (117 lines isn't long), it does take advantage of a number of extra libraries to work.

The SPI (Serial Peripheral Interface) library turns pins D9, D10, D11 into an SPI port to transfer data fast enough to the DMD so that we see a smooth, non-flickering display.

The DMD library converts the commands we issue into actual LEDs lighting up on the display.

We also need the TimerOne library to work with the DMD code to set the display rate timing (that's the 'multiplexing' we talked about at the beginning).

And finally, there's the TimedAction library to create our one-second interrupts.

Code libraries are brilliant inventions because they allow us to incorporate reusable code to save us reinventing the wheel each time. The Arduino web site (**www.arduino.cc**) has lots of freely available code libraries, so before you try coding a function from scratch, see if a suitable code library exists you can leverage off.

GET DESIGNING!

Designing Arduino projects is a two-part process – you figure out the electronics you're connecting to the microcontroller board and then write the code that makes the whole thing work. Start simple and get the very basic features working, slowly building up until you have your project. Just remember to beware of feature creep, otherwise, you may never get it finished! ■

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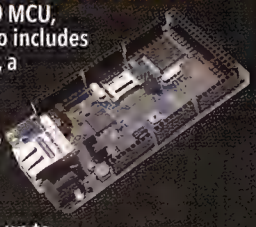

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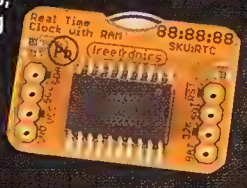

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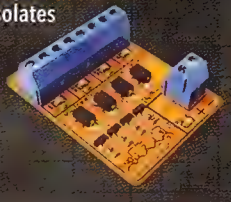

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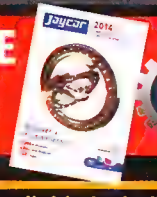

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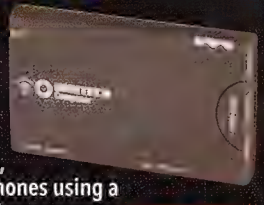

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YN-8329

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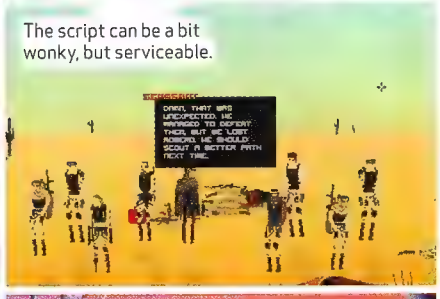
downtime

» GAMES - EDITED BY TROY COLEMAN

Gods have yet to get YouTube.


The script can be a bit wonky, but serviceable.

I dread to think what you'd consider managing badly.

apc HOT PRODUCT

US$10 | PC | GODSWILLBEWATCHING.COM

Gods Will be Watching

Gods will be watching, but it's your job to judge.

This is a game about the fact that you're probably not a psychopath, but that hey, sometimes shit still happens.

First scenario: you're not a terrorist. Your hostages may disagree, but, as you tell them, you're not looking to hurt anyone. They're just there for protection while your team hacks a government server.

Then the timer starts. All you have to do is keep things quiet for your hackers, and keep the guards outside the door out of flashbang range – an instant game over. And everything would be fine, if everyone would just sit and be quiet for a few minutes. But will they? No! Shouting at them doesn't calm them down. Damn it! The computer feed's been hacked again. Have the hackers fix that, then – what now? All this pussyfooting around has made the hostages lose respect and openly rebel. There's an easy way to fix that. Let's hope their leader learns to love hopping.

And so, slowly but surely, in a hundred tiny little steps down that road paved with good intentions, does *Gods Will Be Watching* make you the bad guy. Or the mad scientist. Or the pragmatic military leader, slowed by a wounded soldier.

COLD-HEARTED

This is a very unpleasant, very uncomfortable game to play. It demands cold decisions in nightmare situations and then depicts the results with the heartless edge of a rusty scalpel. In a particularly beautiful little twist of that knife, the game itself stands back from moralising, encouraging you to do it to yourself at the end of each stage, with a *The Walking Dead* style breakdown of how everyone else who played did – a reminder that you could almost certainly have done better.

For the most part, it's extremely effective, squeezes every drop of life out of its pixels, and backs it all with a great atmospheric soundtrack. Where it struggles is that in order to stretch out the handful of stories into a commercial game, each vignette is designed to be challenging, even if you do opt to take the easier – often morally repugnant – shortcuts like thumping hostages. The resulting repetition after things go wrong saps the emotional core of each story, rapidly turning characters into simple puzzle pieces.

The scenarios are long and can't be saved, which can be a real pain if you screw up on something minor, That aside, *Gods Will Be Watching* is a clever idea that is well-executed. It avoids the overt morality of similar games in favour of simply asking you to judge yourself as you see fit. This is a very different kind of adventure that will make you feel bad, but hopefully for most of the right reasons.

■ **Richard Cobbett**

Taking hostages is hard. I'm not robbing that bank any more.

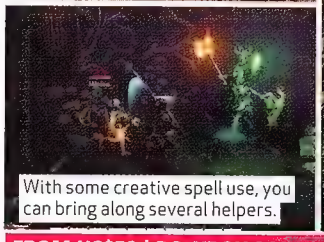
Verdict

An inspired and different take on the concept of 'survival' in games, where you get to bring your own horror.

★★★★½

Alien V. This time they have wings.

Here there be monsters. And you blow them away.



With some creative spell use, you can bring along several helpers.

Nothing a little antacid won't fix

FROM US$50 | PC, XBOX 360, PS3 | RISEN3.DEEPSILVER.COM

Risen 3: Titan Lords

Its hero might be dead, but this instalment brings the series back to life.

Piranha Bytes knows you probably didn't like *Risen 2*, and so the studio symbolically kills it off a mere 30 minutes into the sequel. There's our hero from 2012's pirate-themed adventure, still nameless after all these years and looking as though he just wandered off the set of *Assassin's Creed IV*. But piracy apparently isn't what you want, and so he dies in front of a glowing portal in a ruin without so much as a last "Arr."

Fortunately, he is risen. His corpse spends three weeks fermenting in the tropical sun before he's brought back to life by a loopy shaman. Piranha revives the series with him, and fittingly sends him off in search of his soul. It's a generally fun romp that takes him into deep caves hiding menacing shadow lords, and into bleached dreams where he waxes philosophical with villains from *Risen's* past, but happily it's not the kind of game that demands encyclopedic knowledge of its forebears. *Titan Lords'* tale of securing the help of powerful mages stands quite well on its own.

You can thank the three new factions you can align with for a lot of that. The voodoo of *Risen 2* makes a return in the camps of the 'natives', but they never steal the show quite like their neighbours. The Guardians serve the Mages on their rocky isle, but their melee prowess (and gear) adds a welcome edge to the spellslinger faction by leaving them with a degree of melee prowess. Scowling on stage left, we have my fellow Demon Hunters, who bring a bit of Conan-style grit to the proceedings.

Yet more importantly, the three factions bring magic. This enhances the experience of *Risen 3* so thoroughly that it's appalling to think that its predecessor shipped without it. A chief criticism of *Risen 2* was that the tendency of enemies to gang up on you kept you from attacking, but here I send them flying back with a spell like the Demon Hunter's Shockwave. While they're wiggling from shock, I whip out a crossbow and – thoonk thoonk thoonk – they collapse like dominoes. It's stupid fun.

But let's be candid: it takes a while to reach this state of combat nirvana. *Risen 3* wisely isn't so stingy with gold and gear as its predecessor – nor does it leave the locations of quest objectives open to guesswork – but its core combat does rely on the same dubious dance of parrying, heavy attacks and slashes, despite fancy new animations. *Risen 3* is strikingly bug-free considering the series' reputation, but sometimes obvious hits seem to miss and relentless enemy attacks can still break seemingly well-timed blocks.

But then this is a world where Glory is earned by killing chickens, to say nothing of chopping down liches from other dimensions. Glory is everywhere, and it's used to boost stats that affect our hero's prowess in skills such as Melee or Influence. It's a versatile system, and one that enabled me to turn my Demon Hunter into a battle mage of sorts who wreaked havoc with his battleaxe while summoning demon dogs. Not powerful enough? Buy some lessons from folks around towns. Toss in consumable spells of the crystal and runic varieties and companions from various factions, and you'll find few situations where hope is in short supply.

And situations abound. There's a pleasing balance of combat and story, seasoned with minigames for lockpicking or arm wrestling for extra gold. And bless my beard, the ship battles! Somebody's been playing *Assassin's Creed IV*, and it's paid off. Once our hero nabs a ship, clashes with sea monsters and enemy ships begin – just when the rest of the game starts to slip into a predictable rhythm. The versatile mix of broadside cannon bursts and races to keep powder kegs from exploding ensure the concept never outstays its welcome.

Any concerns? Well, it's not exceptionally pretty. Frankly, *Risen* looks old. But I still didn't want to stop playing. ■ **Leif Johnson**

Verdict

Combat quibbles and muddy graphics do little to spoil the fun of this enjoyable RPG.

★★★★☆

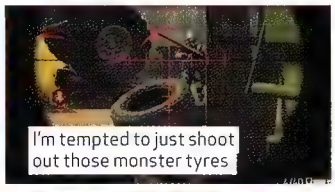
Metro 2033 Redux

A superb survival horror FPS, improved.

FROM US$24.99 | PC, XBOX ONE, PS4 | QWIBOO.COM

It's easy to be cynical and assume this remastered edition of *Metro 2033* is aimed squarely at the console market, whose hardware has only just caught up. Imagine my surprise, then, when this turned out to be an honest to goodness, genuine remaster. A collection of tweaks and polishes that elevate the game to even greater heights. The story so far: the surface of the Earth is scorched and irradiated, so the people of Moscow live in the tunnels of the metro while the Dark Ones plot against them. The genius feature of the game is that you can barter high-grade ammunition for better guns and upgrades. Never before has finding a stash of bullets prompted such an internal conflict. *Metro 2033 Redux* is all this, but looks a lot better. I'm not talking a little texture upgrade here, I'm talking new meshes and animations, and reworked environments. This feels like the definitive version. Cutscenes have been reworked so that the camera never leaves the perspective of protagonist Artyom. There was nothing wrong with wresting the non-interactive viewpoint away from the player from time to time, but in such a tense, atmospheric game, heightening your engagement like this just feels like common sense. So is it worth buying again? Absolutely. Especially since you can get it for half price on Steam if you already own *Metro 2033*.

■ Jem Alexander



FREE-TO-PLAY | PC | WARFACE.COM

Warface

Crytek's free-to-play shooter sets its sights a little low.

***Warface* is Crytek's free-to-play stab at *Call of Duty*'s deathmatch formula, which it spreads across multiple modes, bundles with a thin handful of new ideas, and shackles to an ever-present storefront. *Warface* is the game you play if you fancy running in a circle shooting people in the back but don't want to pay full price for the privilege – which is a reasonable notion – and is also the game you play if you are 10 years old and your parents won't buy you something better.**

I know that because the voices I've heard in-game have, universally, been children; on one occasion I heard someone being told off for not doing their homework. That brief moment of kitchen sink drama was the most fun I've had with *Warface* – a game that is otherwise as oppressively all-right-I-suppose as you'd expect the lovechild of two business models to be.

Warface feels like something you played once in a sticky-floored arcade during a half-remembered summer holiday. It should smell of cigarettes and old carpet. It's low-rent in the way that lightgun shooters traditionally were, and it's this, rather than the *Call of Duty*-shaped hole it aspires to fill, that gives it a personality. It's not a substantially realised thing – it never reaches *House of the Dead* or *Area 51*'s shit-but-kitsch territory – but it's something, and when *Warface*'s angry red LED damage indicators are bursting from the body of a stricken foe there's a little of *Time Crisis* to the experience.

You can press a button to slide along the ground on your butt and earn bonus points for killing someone while doing so. One of the better modes is like *Counter-Strike* with bad maps. There's a capable co-op mode where you fight your way through a series of themed alleyways blasting pigeon-brained AI and sometimes tangling with helicopters or mechs or tanks, an experience that scales up through a series of difficulty levels and that, in its final stages, requires some coordination. It's very repetitive, but it looks OK and it's free.

Warface isn't terrible – I found myself sinking hours into it – but its successes are those of other, better games. If you want a modern military shooter, you should play *Counter-Strike: GO*. Or *Titanfall*. Or one of the earlier *Battlefields*. Or *Call of Duty*. If a free competitive game on PC is what you're looking for, look further; there are lots. This is a game with tame ambitions that manages to achieve a few of them. There's merit there, I suppose, but not enough to warrant a recommendation.

■ Chris Thursten

Verdict

A middling contender in the most oversubscribed genre around, and it trades too hard on being free-to-play.

★★★☆☆

Xenonauts' art style looks plain in the base menus, but from the isometric perspective it's crisp, clean and clear.

US$25 | PC | XENONAUTS.COM

Xenonauts

Tactical strategy that's to be X-Commended.

Situation report. Hundreds of UFOs are orbiting the Earth. Aliens terrorise the world's cities. Multiple 'unexplained' occurrences are being reported, although we suspect the explanation is the aforementioned aliens. Given all that, you would think the globe's governments might give us more than a couple million dollars in funding this month. But no. And all because we let North America get invaded.

Xenonauts' in-depth strategies and tactics make for a welcome homage. As always, you start in the Geoscape – a map of the world that flags alien activity. From here you also manage your base: constructing new facilities, assigning research, manufacturing items and equipping troops. Where *X-COM* required you to manage every item, *Xenonauts* reduces the administration. You're provided with an infinite stock of medkits, grenades and basic weaponry, as befits your status as the organisation separating Earth and enslavement. It leaves you free to concentrate on the high-level strategy of how best to spend your limited resources.

When an alien craft enters your base's radar range, you're given the option to intercept. If downed, you can airstrike the crash site, gaining a small cash boost in the process. More often, you'll want to send in a team – risking their lives for the chance to recover advanced alien loot.

Here's where things get tense. The squad combat is the meat of *Xenonauts*' strategic sandwich. Your troops – up to eight, initially – are deployed on an isometric map, and tasked with eliminating the immediate alien threat. Mostly this involves dying horrifically. The game's turn-based combat delights in punishing mistakes. Failure isn't penalised with a game over, but losing your best soldiers puts you in a poor position for future assaults.

To balance this, you're given extreme leeway in your tactics. Unlike *Enemy Unknown/Within's* prescribed abilities, each soldier in *Xenonauts* is constrained only by their inventory and remaining Time Units. Want to equip a combat shield before pushing forward? That sounds like a solid plan. Want to use explosives to breach a building? It'll probably go wrong, but sure, have fun.

The downside is that it's incredibly slow. Spending half an hour methodically cleaning the map, only to lose the bulk of your squad to a moment of lapsed attention, is enough to make the weaker-willed reach for the reload key. That frustration can be exacerbated when you're wandering a familiar map, repeated from a pool that's just a little too small for the game's long campaigns.

It's not just that its unforgiving, but at times unhelpful. Key concepts, such as the exact workings of different facilities, aren't sufficiently explained. But don't let that put you off.

■ Phil Savage

Verdict

A true X-COM successor, its tactical depth will engross anyone up for the challenge.

★★★★☆

Abyss Odyssey

A picturesque stroll.

US$14.99 | PC, XBOX ONE, PS4 | ABYSSODYSSEY.COM

A skull-faced demon who plays the violin; tree monsters; a winged lion with a mouthful of eyeballs. Much like ACE Team's *Zeno Clash*, *Abyss Odyssey* creates a world that it is a pleasure to be weirded-out by. That weirdness is its best quality. *Abyss* is an ill-conceived mishmash of better fighting and platforming games. Its combat copies *Super Smash Bros.* down to the little quirks: the bubble shield position from which you can dodge to either side, and executing special moves by pressing the attack button and one of four directions. But that combat without the original's iconography and item drops just isn't enough. The procedurally generated levels supposedly make the game different every time you play, but I don't find I need different strategies for facing a giant wooden bull and facing a giant bird man with a spear and shield. There's no need for strategy. I never need to be skilful or smart, because jamming on the attack button and praying is usually just as effective. It took me a few attempts (and under two hours) to defeat the end-boss warlock with the first playable character, the nimble Katrien. That unlocked the slower but stronger Ghost Monk, with whom I defeated the warlock first go. I could keep playing, but why? *Abyss Odyssey* doesn't have a good answer.

■ Matt Bolton

History repeating: PC vs Mac is back

Old (or not so) rivalries resurface, this time with Microsoft on top... well, according to Microsoft.

Apple's much-admired "I'm a Mac" TV ad campaign may have ended its run many moons ago, but its kitschy comic stylings – pitching the differences between Macs and Windows in a short head-to-head skit – have recently been revived. Only this time, it's not Apple calling the shots. Microsoft has debuted a new series of online ads to promote the Surface Pro 3 that once again play up the rivalry between Cupertino and Redmond's offerings, but now it's the limitations of the MacBook Air that are being shown up. In the ads, Microsoft humorously highlights how the Surface Pro 3 (on sale in Australia by the time this issue comes out) pretty much owns the MacBook Air when it comes to stylus support, touchscreen, detachable keyboard and portability, while equalling Apple's laptop line in terms of power, performance and ports. All told they're nice spots that cheekily reference Apple's old ads while pointing out the advantages of the Surface hybrid concept... but it's more than likely Apple will enjoy the last laugh anyhow. While the MacBook Air is unapologetically just an ultraportable notebook – with no new-fangledness in its form factor to speak of – it's still been a runaway commercial success for Apple. The Surface, though? Not so much. Recent figures suggest the Surface line has run up a whopping US$1.7 billion loss for Microsoft since the first model was introduced in 2012. Ouch. Will the Surface Pro 3 be able to turn things around?

RIDE WITH THE DEVIL

It's hard to fight over cabs when they're already fighting each other.

The growth of ride-sharing startups like Uber and Lyft – the popular apps which provide an on-demand alternative to taxis, letting users request, track and pay their driver via smartphone – may tell a very contemporary, digital-driven success story, but recent allegations of dodgy competitive practices in the ride-sharing industry sound like nothing but old-fashioned playing dirty. In a tit-for-tat spat, Lyft claimed Uber drivers requested then cancelled some 5,560 rides on the Lyft service since October 2013, in a bid to hurt the competition by decreasing Lyft's car availability (and at times requesting very short rides and using the trip as a recruiting exercise, urging the drivers to defect over to Uber!). Uber, which is available in Australia – unlike the US-only Lyft – later claimed Lyft's accusations were "baseless and simply untrue" before accusing its rival of the very same kind of dealings: cancelling 12,900 Uber trips as part of a "go nuclear" strategy against the company! It's all very he-said she-said, but only one thing's for sure at the end of the day: the credibility and image of the ride-sharing industry at large is at risk as long as two of its most prominent representatives insist on playing out their little PR war in public. If these juvenile businesses want us to trust them – with our patronage and physical safety, no less – it wouldn't hurt to display a little maturity and class. Grow up!

apc PRESENTS

PC BUILDER

A COMPLETE GUIDE TO BUILDING A GAMING PC

COMPONENTS

PRODUCT RANGE

RIG BUILD

HOW TO

GLOSSARY

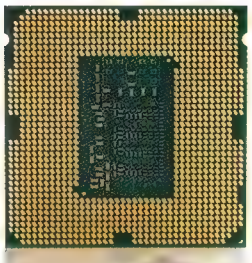
Welcome

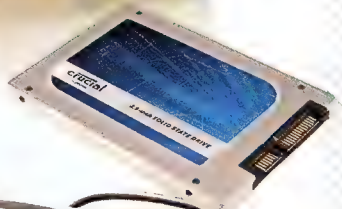
Welcome to APC magazine's guide to building a gaming rig. Inside you'll find a thorough breakdown of what each component is and why you'll need it, the best gear for your preferred price range, as well as a ten step guide to putting it all together.

Putting a PC together is actually a lot simpler than you'd think, but there are a few things you should be wary of when deciding what's best for your system. Be sure to assess each price range, because there's often only a few dollars difference between a low and mid-range stick of memory, for instance.

Similarly, there's a whole world of other gaming peripherals out there that we haven't detailed here, including headsets and gamepads. The purpose of this book is to get your PC in operating order, which means we haven't detailed operating systems either: you should factor in a purchase of the latest Windows operating system (unless you want to use Linux).

The APC team





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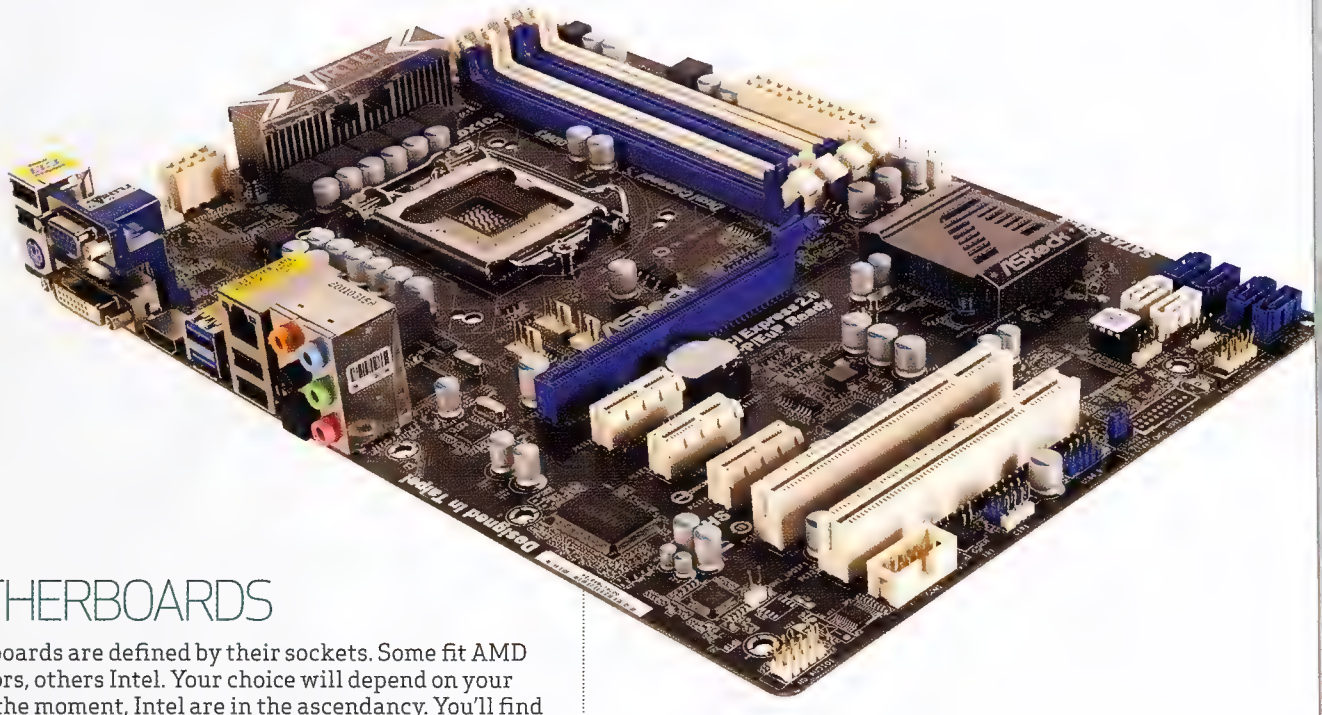
WWW.FSPLIFESTYLE.COM

Pieces of the puzzle

We uncover all the bits you need to know about in order to build a PC from scratch.

Building a PC requires a somewhat long list of individual parts. Like anything there's a price range from the budget friendly, up to 'How am I going to pay rent?' expensive. Depending on what type of PC you want to end up with and how much you hav to spend, you'll need to select different components. Read on to find out which ones are key for any build.



MOTHERBOARDS

Motherboards are defined by their sockets. Some fit AMD processors, others Intel. Your choice will depend on your CPU. At the moment, Intel are in the ascendancy. You'll find no shortage of articles and reviews praising Intel's 4th-Generation Core CPUs. Most agree they're the only option if you're buying a new chip right now. But when it comes to figuring out which motherboard to partner with a new Core i3, i5 or i7 chip, there's a lot more choice and far fewer articles. Which is why we've put together this handy guide.

There are hundreds of boards with Core i3, i5 and i7 compatibility. Where do I start?
By working out which boards support your chosen processor. Many modern gaming PCs use Intel's Core i5 processors, meaning you'll be wanting a board with an LGA 1150 socket. Each socket also has certain 'chipsets' that allow you to do different things with your motherboard. Do your research before buying either component, and tailor them to fit.

That's pruned it down a bit. Anything else I need to know?
The chipset, by the way, is the collection of core logic chips that motherboard makers buy from Intel and build their boards around. These define things like the number of graphics cards, USB ports or SATA connections. There are a range that support Intel's newest LGA 1150 processors, but the key ones released this year are H97 and Z97. The Z97 is your best bet if you want a top-end gaming motherboard.

I want the best. Hit me with it.

Top of the line are motherboards based on the Z97 chipset. These have everything, and then a bit more. They can support up to four PCI Express graphics cards simultaneously and open up all the overclocking features of the highest-end CPU. Z97 motherboard offer lots of expandability and can have up to six USB 3.0 and six SATA 6Gb/s ports, plus built-in RAID support.

What about H97 and older 8-series chipsets?
H97 boards don't have quite the range of features and expandability as Z97 (and often don't support overclocking) but they're usually cheaper and still have all the features most users need. The H87, Z87 and other 8-series chipsets were designed for Intel's previous 2013-model Core processors. There are a lot of these 8-series boards still on the market, and they are a good option if you've picked up a 4th-Gen CPU on the cheap.

What about AMD?
You'll be wanting an AM3+ socket for AMD's latest FX series processors. If you've somehow got an even older Phenom II chip, you'll need a socket AM2+ or AM3.

PROCESSORS

Modern processors are dominated by Intel's Core i series, the most recent of which are known as 'refreshed' 4th-Generation Core chips, a slight upgrade of the original 4th-Gen models from 2013. They're easy to spot – having the prefix '4' attached to their model numbers – but the jump in model doesn't necessarily correlate to a straight upgrade: if you've got a 3rd-Gen Intel chip already, it's likely not worth upgrading to 4th-Gen. If you do need a new CPU, read on for a quick reminder of what's important and what you should look for.

What's new with Intel's 4th-Generation Core chips?
There aren't massive changes from the previous generation of Core processors from Intel. This is very much a refinement of what's gone before, and the primary difference being greater power efficiency with a slight performance boost over their predecessors. Both 3rd- and 4th-Gen chips are based on a 22nm manufacturing process.

Should I get a Core i7 or a Core i5?
They're nearly identical except for hyperthreading – the ability for each core to run two processes simultaneously. Core i7s have it – making them super efficient – Core i5s don't. It's not essential for gaming, however, so you're better off looking for the chips with a 'K' suffix, which indicates they're suitable for overclocking.

Will I need a new motherboard?
Possibly not. While there are new 9-series motherboards made for 'refreshed' 4th-Gen processors, the physical socket is the same 1150 pin design. With a BIOS flash, most older 8-series systems that supported last year's chips should recognise the new models too.

What about AMD?
AMD's chips are split into two main groups, the FX family (the top-end performance line) and the mainstream range of A-series APUs (accelerated processing units), which more aggressively combine the CPU and GPU into a single chip.

RAM

As applications and games get bigger and more complex, they take need more space to work in. Most modern systems are fitted with 8GB of RAM. Partly, that's due to price – RAM is quite cheap at the moment. But is that the only reason to upgrade? Read on to find out.

What is RAM?
Random Access Memory is the superfast solid state storage which the CPU uses for data it's working on. Think of it as a pipeline – data is taken from the hard drive and moved to the RAM when the CPU thinks it might need it, and transferred back again when it's done.

What's DDR? (No, it's not 'Dance Dance Revolution'.)
Another name for memory. It stands for 'Double Data Rate' and means RAM chips which can transfer a bit of data on both the up and down ticks of a single clock cycle. DDR2 improves that by using a 2x clock multiple to double the effective speed, while DDR3 doubles up to a 4x multiplier again.

I'm a bit confused by that.
All you need to know is that the rated speed of RAM – 1,600MHz, for example – isn't actually the speed it operates at. Rather it's an equivalent. What you really have is 200MHz RAM transferring data eight times per clock cycle. To further the difficulties, DDR3 is also sometimes referred to as PC3.

What about latencies?
Latency is generally measured in CAS timings. Confusingly, DDR3 appears slower than DDR2, with CAS9 being a common spec compared to CAS5 or CAS6 for DDR2. Really, though, the two figures aren't comparable, as longer CAS times on DDR3 aren't necessarily slower. It's not as important a measurement as it used to be.

COOLERS

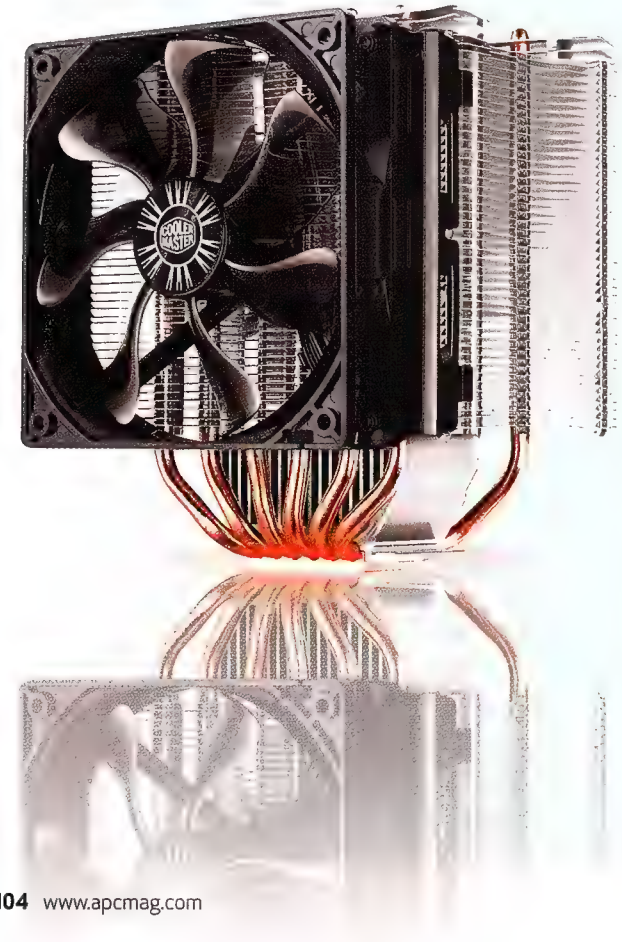
What's a heatsink?
It's the large metal unit on top of your CPU, which is designed to draw warmth away from the chip and disperse it into the rest of the case.

Why do I need one?
Computer processors generate heat as electrons flow through their silicon pathways. Unfortunately, heat also upsets the movement of said electrons, causing errors in calculations or causing a chip to cease functioning altogether. The harder a chip works, the hotter it gets, and the hotter it gets the slower it will run so the harder it has to work.

See the irony there?

How do heatsinks work?
The base, or 'block', of a heatsink is made from a highly conductive material (usually copper), which is clamped tightly to the top of your CPU. Thermal paste is used to fill any microscopic air pockets that might prevent heat transferring from the CPU to the heatsink base. Running through this block are a series of heatpipes, which take the heat away from the CPU and transfer it to radiator fins, which are cooled by a fan.

Do I need to upgrade my stock cooler?
Maybe. The stock coolers that come with Intel's current Core CPUs are tiny, almost silent and support a bit of overclocking. But they're certainly not the best option available, since a high-power heatsink can cost you less than $50 these days.



MONITORS

Still using that crusty old CRT or early 19-inch LCD screen with washed-out colours and a 4:3 display ratio? With LCD monitor prices at an all-time low there's really no excuse not to get something a little more modern. You won't regret it: it's a good way to make your games look better.

What should I look for?
A good monitor will have a wide dynamic range of colours and be capable of displaying bright whites and dark blacks, with rich tones between. The trouble is that you can't read this off the specs sheet – all screens will claim they can show in excess of 16 million colours. The important thing is which 16 million colours those are.

Which type of screen has the best picture quality?
There are four types of screen technology currently available: TN, VA (including MVA and PVA), IPS and OLED. Of these, VA is increasingly rare and OLED is extraordinarily expensive, so you'll find the choice is between TN and IPS. IPS screens have better looking and more accurate colours, a wider dynamic range and broader viewing angles. TN screens have a faster response time, which means individual pixels change state more quickly, and are thus less liable to ghosting. It used to be the case that IPS screens were more expensive, but newer e-IPS panels are just as cheap as TN screens. They're not quite as good as older IPS technologies, though, as they produce some colours through dithering.

What's dithering?
Say you want a light blue pixel, but your monitor can't display that particular shade; you could use a slightly darker blue and 'mix' it with white. The mixing process involves flickering between the dark blue and white tones so rapidly the eye blends them together. That's dithering.

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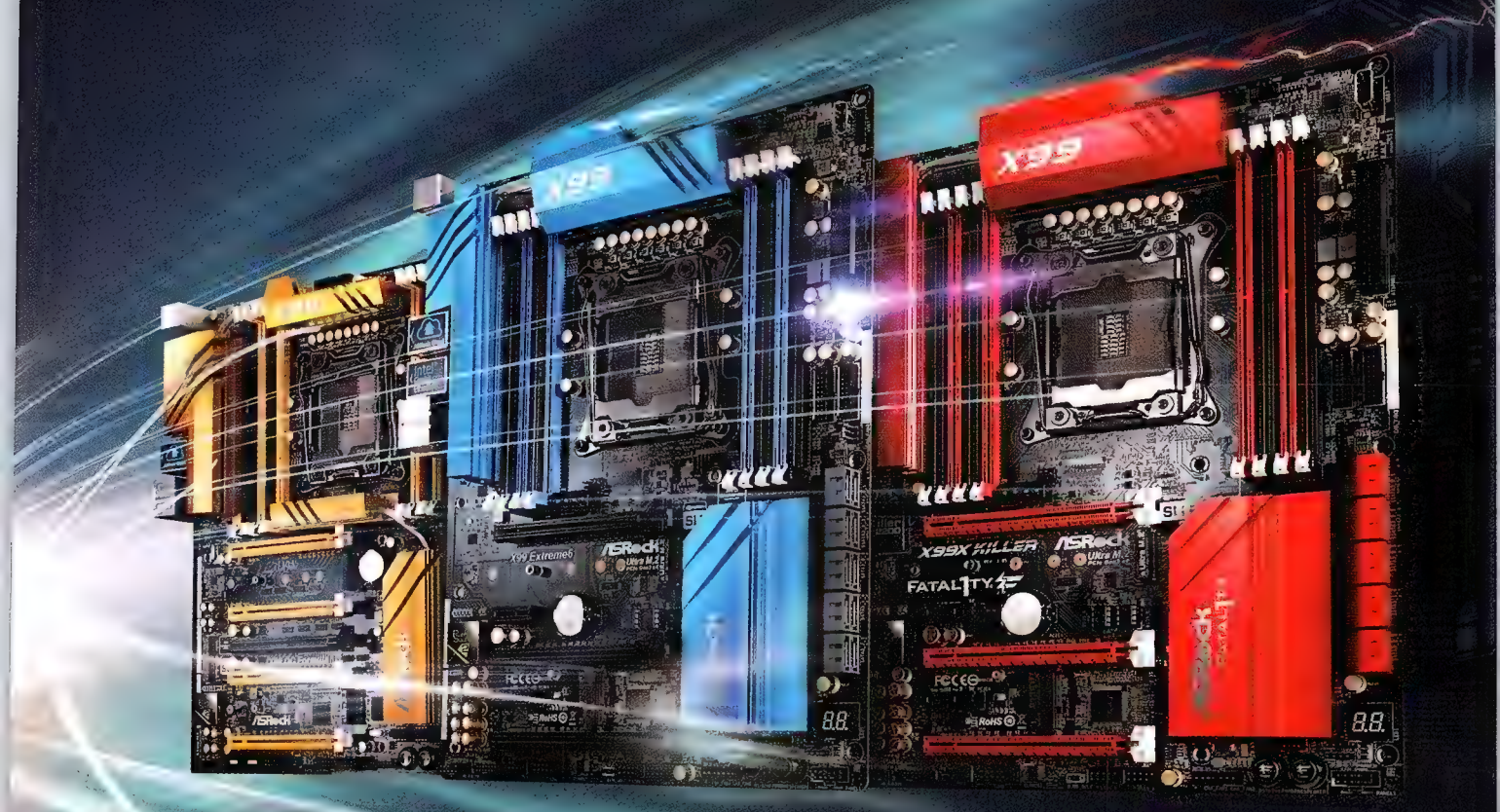

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PC Mod	02 9746 7886	pcmod.com.au
D & D COMPUTER TECH	02 9742 3988	ddcomputer.com.au
DIY COMPUTERS	02 9897 9993	diycomputers.com.au
MAIG PTY LTD	02 9648 2261	maig.com.au
J&W	02 8090 3332	jw.com.au

QLD

Computer Alliance Pty Ltd	07 3420 3200	computeralliance.com.au
Game Dude Pty Ltd	07 3387 1500	gamedude.com.au
MSY	07 3290 1738	msy.com.au
Umart Online	07 3369 3928	umart.com.au
AUSCOMP COMPUTERS	07 3722 5100	auscompcomputers.com

VIC

Computers & Parts Land	03 8542 8688	cpl.net.au
MSY Technology	03 9560 2288	msy.com.au
PC Case Gear	03 9551 0889	pccasegear.com
Centre Com Sunshine PTY	03 8311 7600	centrecom.com.au
Scorpion Tech. Computers	03 8561 3200	scorptec.com.au

NT

PC Solutions 4 U	08 89412119	pcsolutions4u.com.au

TAS

Principal Computers	03 6235 5000	tasmanianpc.com.au

WA

Austin Computer	08 9201 2788	austin.net.au
MSY	08 9344 1002	msy.com.au
Netway Computers	08 9332 0888	netwaycomputers.com
Netplus Micro Computers	08 9242 7288	netplus.com.au
PC West	08 6398 4813	pcwest.com.au
PLE Computers	08 9309 4771	ple.com.au
Worldwide Net Solutions	08 9375 9666	netsolution.com.au
ARROW COMPUTERS	08 9258 7733	arrowcomputers.com.au

SA

Hypernet Computer Distribution	08 8340 2021	hypernetdist.com.au
MATS Systems	08 8186 2110	mats-systems.com.au
MSY Technology (SA) Pty Ltd	08 8212 1656	msy.com.au
IT&Computers	08 8186 2736	itwarehouse.com.au
Photech Computers Pty Ltd	08 8349 4334	photech.com.au

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www.asrock.com

CASES

Why would you want to replace a perfectly serviceable PC case? After all, it's not like the coffee stains or the fact that the side doors don't shut properly really affects performance, is it? Actually, as well as looking a bit dilapidated your old PC case can probably be improved upon in a number of ways. A new case might be bigger, for those enormous graphics cards, or quieter with better airflow. Or maybe you want to build a system that takes up less space?

What should I look for in a case?
These days, it's mostly down to personal taste. As PC parts are all standardised in terms of size and shape, physically any case from the last twenty years or so should be able to fit modern components. The ATX spec dictates the actual size – a case designed for smaller micro-ATX motherboards won't take full length ones – but other than that everything should go together well. Just look out for extra clearance width-wise if you want to use a large CPU cooler, or a bit of extra length if you're fitting a large graphics card.

So technically there are no differences?
Of course there are, but even the cheapest cases now have some of the most important features, such as clear airflow directed from front to back for the best cooling. Most will also have a modern cable management system, which means holes cut into the motherboard mounting plate so you can feed cables behind the tray and prevent them from obstructing air.

What about noise?
From a CPU's point of view, lots of fans which draw air in from the front of the case and then vent it out the back are a good thing, along with fans on the top and sides. From your significant other's perspective, large fans which spin slowly and quietly are a good thing, especially if there's a manual controller to slow them into silence.

Power supplies (PSUs)

Don't neglect it: it's the component that powers the rest of your PC!

The PSU doesn't get much love from most PC builders. It's often the last component anyone picks, but in some ways it's the most critical — if it carks it, it'll render the rest of your system unusable too (at least until you get a replacement). It's therefore just as important to pick a good PSU as any other component in your build.

So what does it do?
The PSU is in charge of taking mains power and splitting it up into all the different types of power that components in your system require. The motherboard, graphics card and hard drives all have different needs, so the PSU provides power at widely varying levels to keep them all happy.

How much power do I need?
That question largely hinges on two other components — the CPU and the graphics card. If both of these are relatively modest, like they are in our AMD budget PC on page 108, you should be fine with a roughly 550W power supply — we'd recommend the Antec VP550P (at around $80) as a good entry-level option. Unless you're running multiple graphics cards in SLI or CrossFire, or an extremely power-hungry CPU (like Intel's enthusiast and professional-pitched LGA2011 parts, which are beyond what we've recommended here), most mid-range to higher-end systems should only need a slight jump up to a 750W PSU — something like Seasonic's $160 S12G is our pick for a solid and reliable option.

SOLID STATE DRIVES

It's only been around 5 years since the first solid state drives (SSDs) appeared for domestic desktops, but they've been one of the fastest evolving technologies we've seen. They can produce a noticeable improvement to overall performance in a way other components can't.

What is this magical storage tech?
Traditional hard drives store data on spinning platters of magnetic material. SSDs use flash memory chips similar to the ones in camera memory cards and USB sticks.

What are the advantages of SSDs?
First of all, there are no moving parts. You could possibly put an SSD through the washing machine without breaking it (no, we're not going to try). SSDs are also faster than traditional hard drives – at least under most circumstances. Seek and read operations are especially fast, and the latest drives can drag data from a drive at over 500MB/s. That's fast.

When might that be an advantage?
For gaming, SSDs should make the biggest difference when it comes to load times. Games are slowed down by the vast amounts of data that they need to shift over from the hard drive to the system RAM and graphics buffer, and SSDs can reduce this time by several factors. Also, they can speed up Windows boot times and HD video encoding; they're useful any time that the CPU is limited by the hard drive.

What are the disadvantages?
They're still more expensive than hard drives, and they can only take a set number of read/write cycles before they die. (Typically though, it'll take years of use to reach the point where that's a problem.) More critically, there's a risk that SSD storage can slow down over time if it's not set up correctly.

GRAPHICS CARDS

Things change fast in the world of 3D cards. At the time of writing, AMD has its R7 and R9 series, all based on the Graphics Core Next architecture. Nvidia, meanwhile, has the 700-series GeForce cards, which are (a little confusingly) based on three different architectures. Whether you bought a new graphics card in January or back in 2006, there's new stuff out, so it's time to take stock and ask whether or not you need to upgrade. Here's where you get up to speed.

AMD or Nvidia?
The question of which brand graphics card to buy is an old one. Unlike CPUs, where Intel has ruled the performance end of the market for many years, the trophy for fastest graphics card has gone back and forth between AMD and Nvidia a few times over the past half a decade. Both companies have good cards and have, of late, been focusing on offering more value outside just performance. AMD, for example, is know for its game bundles, which let you download several recent-release games if you buy one of its mid or high-end cards. Nvidia has gone for a different approach, offering the ability to capture gameplay videos and stream PC games to devices like its Android powered Shield handheld console and the just-released Shield Tablet (which is not yet available in Australia).

So which card should I get?
At the low end, AMD's got some quite compelling R7 cards (and the R9's aren't too shabby either), but Nvidia's mid-range and top-drawer cards are best for both performance and power efficiency. If you want to get *Battlefield 3* running in Ultra mode with all the details up, the GTX 770 is about the best way to do that.

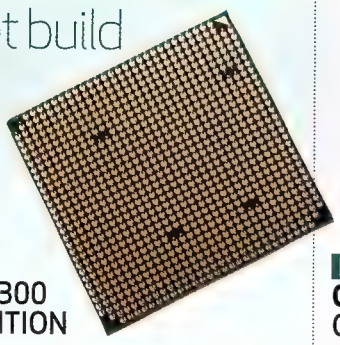
How about multi-card SLI or CrossFire?
How about it? Given the power of both AMD's R9 290X and Nvidia's GeForce GTX 780, you only need to start thinking about dual graphics cards if you're planning on using three screens for gaming. Or thinking of gaming in stereoscopic 3D, maybe. ■

What should I buy?

We've put together three different example builds at three price points to help point you in the right direction.

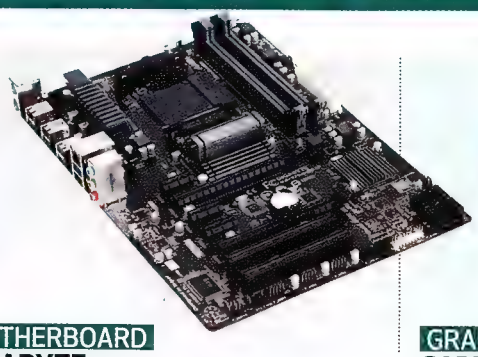
It's simple, really: how much do you want to spend? We've provided three price tiers which provide a broad view of some of the best gear on the market within their price ranges. They may not represent the cheapest and/or most expensive in their categories, but we've selected them on the grounds that we believe they'll hold you in good stead. Plus, they're all available in Australia too, which is handy.

Budget build



CPU
AMD FX-6300 BLACK EDITION

PRICE $140
MANUFACTURER AMD
WEB WWW.AMD.COM
CORES SIX
CLOCKSPEED 3.5GHz
SOCKET AM3+
CACHE 14MB
TDP 95W
A perfectly serviceable low-budget CPU which can be overclocked from the 3.5GHz base speed all the way to 5GHz.



MOTHERBOARD
GIGABYTE GA-970A-DS3P

PRICE $120
MANUFACTURER GIGABYTE
WEB WWW.GIGABYTE.COM.AU
SOCKET AM3/AM3+
CHIPSET AMD 970
MEMORY 32GB DDR3-2000
SLOTS PCIE X16, PCIE X4, 2X PCI, 3X PCI X1
A full-sized board with SATA 6Gbps storage and USB 3.0 compatibility. Boasts features unusual in the low-budget motherboard including dual-BIOS.

GRAPHICS CARD
SAPPHIRE DUAL-X RADEON R7 265 BLACK EDITION

PRICE $200
MANUFACTURER SAPPHIRE
WEB WWW.SAPPHIRETECH.COM
MEMORY 2048MB
CHIPSET AMD R7 265
This is your best option if you're after 1080p-level performance at under $200.

SSD
SANDISK 128GB ULTRAPLUS

PRICE $95
MANUFACTURER SANDISK
WEB WWW.SANDISK.COM.AU
CAPACITY 128GB
128GB is the lowest sensible option for a gaming PC storage wise. This drive combines solid performance and good reliability at a nice price.

CASE
CORSAIR CARBIDE 200R

PRICE $90
MANUFACTURER CORSAIR
WEB WWW.CORSAIR.COM
FORM FACTOR ATX
MATERIAL STEEL
PORTS HEADPHONE, MIC IN, 2X USB 3.0
DRIVE BAYS 4X 2.5IN/3.5IN, 3X 5.25IN
FANS 2X 120MM
While there are cheaper cases on the market, this one does away with rattling and vibrations and has adequate venting.

RAM
G.SKILL F3-12800CL9D-4GBNQ

PRICE $65
MANUFACTURER G.SKILL
WEB WWW.GSKILL.COM
CAPACITY 4GB
CONFIGURATION 2X 2GB
Taking up two slots for 4GB RAM isn't ideal nowadays, but 4GB should sort you for a lot of hungry titles. Still, the midrange option is better if you've got some extra dollars.

MONITOR
BENQ GL2460HM

PRICE $190
MANUFACTURER BENQ
WEB WWW.BENQ.COM.AU
SIZE 24-INCH
RESOLUTION 1,920 x 1,080
This 24-inch wide, LED-backlit monitor is Full HD 1080p (16:9 aspect ratio); you'll be hard pressed to find better for under $200.

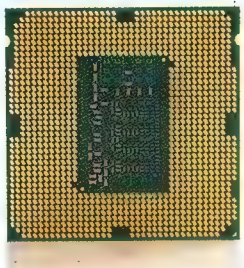
MOUSE
LOGITECH G400S

PRICE $45
MANUFACTURER LOGITECH
WEB WWW.LOGITECH.COM
SENSOR 4,000DPI
A great optical gaming mouse at a wallet-pleasing price.

KEYBOARD
THERMALTAKE POSEIDON ZX

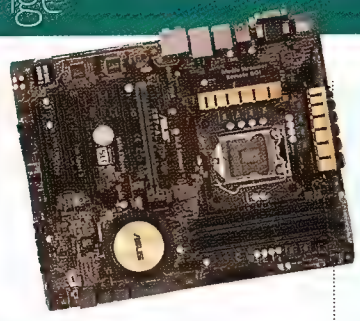
PRICE $90
WEB WWW.THERMALTAKE.COM.AU
MANUFACTURER THERMALTAKE
This wired, blue-switched mechanical keyboard ditches the numpad for a nice compact design and lower price, but keeps the performance intact.

Mid-range build



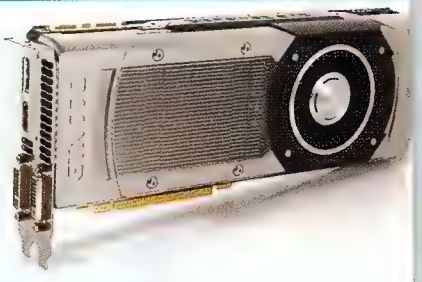
CPU
INTEL CORE I5-4690K

PRICE $275
MANUFACTURER INTEL
WEB WWW.INTEL.COM
CORES/THREADS 4/4
SOCKET LGA1150
CLOCKS 3.5GHz BASE, 3.9GHz TURBO
CACHE 6MB
PROCESS 22NM
This new 5th-gen Intel Core chips is the go-to CPU for mid-range gaming rigs, where high performance is the goal.



MOTHERBOARD
ASUS Z97-A

PRICE $200
MANUFACTURER ASUS
WEB WWW.ASUS.COM/AU
CHIPSET INTEL Z97
SOCKET LGA1150
CPU SUPPORT 4TH GEN INTEL CORE
STORAGE 8X SATA 6GB/S
Since its release earlier this year, the Z97-A has won numerous plaudits for its feature rich environment, which puts similar motherboards in higher price ranges to task.

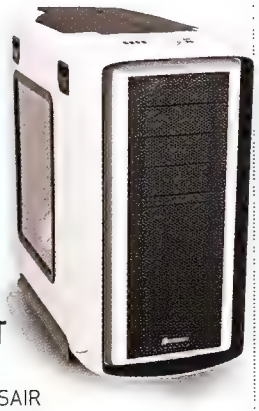


GRAPHICS CARD
NVIDIA GEFORCE GTX 770

PRICE FROM $390
MANUFACTURER NVIDIA
WEB WWW.NVIDIA.COM
GPU GK104
CUDA CORES 1,536
CORE CLOCK 1,046MHz
MEMORY 2GB GDDR5 @ 7GHz
MEMORY BUS 256-BIT
Currently the go-to graphics card for mid-level rigs. It's on the higher price spectrum for a mid-range card, but it's worth the extra dollars.

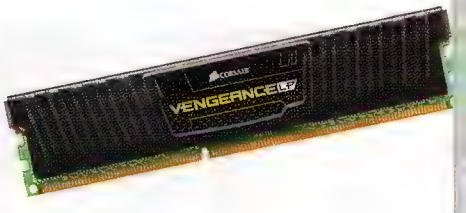
SSD
CRUCIAL MX100 256GB

PRICE $160
MANUFACTURER CRUCIAL
WEB WWW.CRUCIAL.COM
CAPACITY 256GB
High read and write speeds, solid reliability and a very reasonable price make this SSD a perfect mid-range slab.



CASE
CORSAIR SPECIAL EDITION GRAPHITE 600T

PRICE $210
MANUFACTURER CORSAIR
WEB WWW.CORSAIR.COM
FORM FACTOR FULL ATX, MICRO-ATX
FANS 2X 200MM, 1X 120MM
I/O PORTS 1X USB 3.0, 4X USB 2.0, FIREWIRE, AUDIO IN AND OUT
A chassis with ample space and a cooling system which should keep internal temperatures down to 30°C, even with the hottest tech onboard.



RAM
CORSAIR VENGEANCE LP 8GB

PRICE $100
MANUFACTURER CORSAIR
WEB WWW.CORSAIR.COM
CAPACITY 8GB
CONFIGURATION 2X 4GB
Two sticks totalling 8GB (4GB per stick) means you won't use up too much space. A nice mid-range price point for this much grunt.

MONITOR
BENQ GW2765HT

PRICE $500
MANUFACTURER BENQ
WEB WWW.BENQ.COM.AU
SIZE: 27 INCHES
RESOLUTION: 2,560 x 1,440
This beautiful 27-inch LED-backlit IPS screen offers the next step up from 1080p resolution, known as 1440p, for nice sharp images on a big screen.

MOUSE
STEELSERIES SENSEI RAW

PRICE $65
MANUFACTURER STEELSERIES
WEB WWW.STEELSERIES.COM
SENSOR 5,700DPI
A plain-but-comfortable ambidexterious design and solid-performing 5,700dpi laser sensor make the Sensei RAW a relative steal.

KEYBOARD
CORSAIR VENGEANCE K65

PRICE $120
MANUFACTURER CORSAIR
WEB WWW.CORSAIR.COM
Corsair's cheapest mechanical-keyswitch keyboard may be short a numerical pad, but who needs one anyway?

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STREAMING ENGINE

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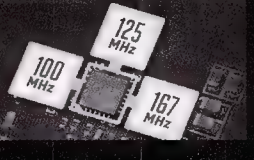
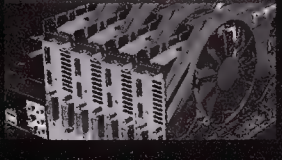
Fantastic Full HD hardware streaming.

Turbo M.2 32 Gb/s

OC Engine

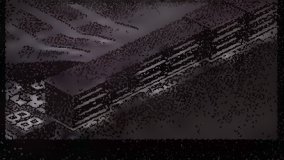


Quad SLI/ CF



DDR4-3333(OC)

SATA Express



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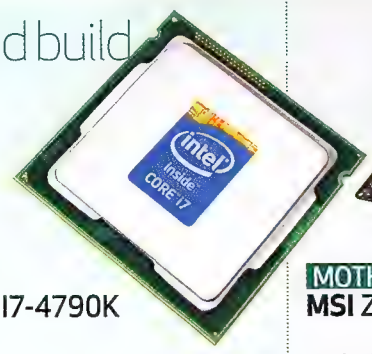
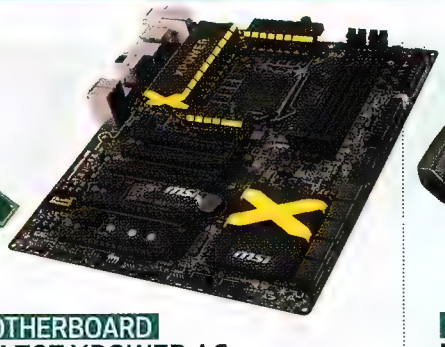
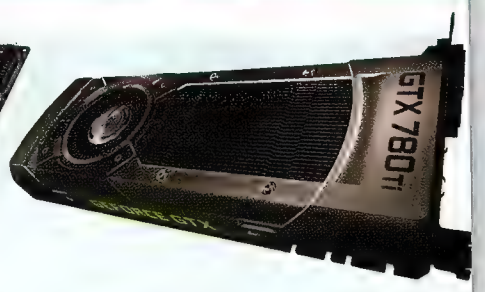
MSI Australia

High-end build







CPU
INTEL CORE I7-4790K

PRICE $400
MANUFACTURER INTEL
WEB WWW.INTEL.COM.AU
CORES/THREADS 4/8
SOCKET LGA1150
CLOCKS 3.6GHz BASE, 4.0GHz TURBO
CACHE 8MB
PROCESS 22NM
While there are technically faster CPUs out there, few will result in noticeably better performance and this chip is easily the standard bearer at present.

MOTHERBOARD
MSI Z97 XPOWER AC

PRICE $520
MANUFACTURER MSI
WEB AU.MSI.COM
CHIPSET INTEL Z97
SOCKET LGA1150
CPU SUPPORT 4TH GEN INTEL CORE
STORAGE 10X SATA 6GB/S
While this motherboard may seem absurdly expensive (and it is) it's packed with every feature you could want (including 802.11ac Wi-Fi) and offers some crazy overclocking potential.

GRAPHICS CARD
NVIDIA GEFORCE GTX 780 TI

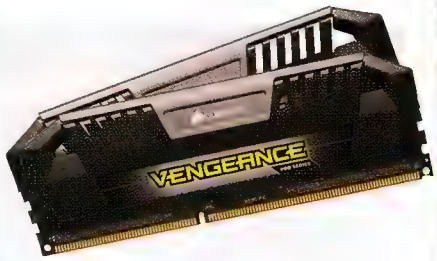
PRICE FROM $760
MANUFACTURER NVIDIA
WEB WWW.NVIDIA.COM
GPU GK110
CUDA CORES 2,880
CORE CLOCK 875MHz / 928MHz BOOST
MEMORY 3GB GDDR5 @ 7GHz
MEMORY BUS 384-BIT
The current high water mark of consumer GPU technology, the GTX 780 will make your wallet a little flatter but you won't find anything better under $800.

SSD
SAMSUNG 840 EVO 1TB

PRICE $475
MANUFACTURER SAMSUNG
WEB WWW.SAMSUNG.COM/AU
CAPACITY 1TB
If you're not skimping there are few better options than the Samsung 840 EVO, and 1TB of storage space will give you heaps of room for games.

CASE
COOLER MASTER COSMOS 2 ULTRA

PRICE: $369
MANUFACTURER
COOLER MASTER
WEB WWW.COOLERMASTER.COM
FORM FACTOR FULL ATX, MICRO-ATX, E-ATX, XL-ATX, SSI CEB, SSI EEB
FANS 1X 200MM, 3X 140MM, 3 X 120MM
I/O PORTS 2 X USB 3.0, 4X USB 2.0, 1X E-SATA, AUDIO IN AND OUT
The Ferrari of PC cases, you may find it unjustifiable to spend nearly $400 on a case, but if you do you'll find this one has features and room to spare.



RAM
CORSAIR VENGEANCE PRO 1,866MHZ 16GB

PRICE $230
MANUFACTURER CORSAIR
WEB WWW.CORSAIR.COM
CAPACITY 16GB
CONFIGURATION 2 X 8GB
With two 8GB sticks comprising a total of 16GB, you'll have ample memory for any high-end task that demands heaps of swap space.

MONITOR
ASUS PB287Q

PRICE $800
MANUFACTURER ASUS
WEB WWW.ASUS.COM/AU
SIZE 28 INCHES
RESOLUTION 3,840 x 2,160
This 28-incher gets you 4K 'Ultra HD' resolution at a comparatively nice price. If money's really no object, switch up to the ASUS PQ321QE – it's a 31.5-inch 4K screen at $3,300.

MOUSE
RAZER TAIPAN

PRICE $90
MANUFACTURER RAZER
WEB AU.RAZERZONE.COM
SENSOR 8,200DPI
A beautiful-to-the-touch ambidextrous mouse which will be ideal for competitive twitch shooters.

KEYBOARD
CORSAIR VENGEANCE K70

PRICE $170
MANUFACTURER CORSAIR
WEB WWW.CORSAIR.COM
Corsair excel in the 'keyboard as fashion accessory' stakes, and this Vengeance K70 looks as good as it feels. ■

Thermaltake

Pure Performance.
Built for Enthusiasts by Enthusiasts.

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Never worry about running out of power again with LUXA2's fashionistic, outdoor, heavy duty, EnerG series and wireless portable power banks.

2 HOLDER SOLUTIONS :
LUXA2's smartphone and tablet holders provide effortless use and safe viewing of your device, whether it is for work or play.

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Enhance your musical experience with LUXA2's immersive Bluetooth wireless stereo speakers, taking and sharing your favorite tunes, wherever and whenever.

4 GAMING HEADSETS :
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Tt eSPORTS' comprehensive mouse pad selection encompasses different sizes, materials, and surface styles to offer you the right control & glide.

8 DOCKING :
Thermaltake offers a comprehensive and easy way to access files from all types of external and internal storage devices to provide the ultimate experience in data solutions.

9 CHASSIS :
Experience the next generation of chassis design! Thermaltake has a series of enthusiast-focused chassis for any type of system or configuration.

10 COOLING :
Thermaltake coolers consistently exceed user expectations by providing the most innovative coolers to protect our customers' CPUs and systems; it is time for you to enjoy optimized cooling performance.

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Case fans by Thermaltake precisely balance efficiency with quiet cooling performance. Just add your selected styles into the PC case.

12 POWER SUPPLIES :
We bring state-of-the-art technology to our users. Thermaltake PSUs have a reputation for efficiency and reliability while providing the most revolutionary technology; our PSUs are eco-friendly and a logical energy-saving solution.

Thermaltake Brands

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www.ttesports.com

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Let's build this thing!

Parts gathered, tools ready, time to get started.

Now it's time to get your hands dirty. Well actually, you probably don't need to get them dirty at all. Building a gaming rig is a pretty clean process, provided you don't do it in a swamp!

Enough whimsicality though, because you'll need to concentrate for this. Over the next ten steps you'll find a pictorial guide which will help you in the process of piecing your gaming rig together. We've excluded several important steps on the basis that they are very easy. These include: plugging in your mouse and keyboard, turning the computer on, and connecting it to the internet.

1 NOT SO FAST!

As always, the temptation to simply grab all your newly-bought goodies and jam them straight into your awaiting chassis can be overpowering, but resist! It's a lot simpler to discover if one of your new components is dead on arrival before you've spent an age seating them just so in your case. If anything needs to be replaced, you're better off finding out now. Use the anti-static bag your mootherboard came in and rest the board on the bag on top of its box.

2 FIT THE CPU AND RAM

Drop the CPU into the waiting socket and slot the RAM modules into the marked DIMM 1 and DIMM 2 sockets if you're just using a pair of sticks. The DIMM slots should be labelled on the motherboard PCB and you may find your board won't pass POST if they're in the wrong slots, so check the motherboard manual to be doubly sure. With the board on the box, you can also attach the graphics card and seat it snugly in the primary PCIe socket.

3 GET PASTED

Next you want to attach the cooler to the processor, but first you need some thermal paste to ensure a decent contact. You only really need a blob of thermal goo about the size of a grain of rice, because the CPU plate will spread the paste out when you screw it down. Your cooler will probably come with a one-shot parcel of paste, but if you fancy getting in on the overclocking action, it might be worth buying some more separately.

4 POWER IT UP

With the graphics card in the primary PCIe slot, attach the power cables to both the motherboard and GPU. You don't need to connect the SSD yet because we're just going to check the machine reaches the BIOS stage. Plug your screen into the graphics card, plus a keyboard into the mobo, and power up your bare bones system. If all is well, the monitor will burst into life and you'll be able to get yourself into the BIOS pages. Power down and let's get building properly.

5 FIT THE PSU

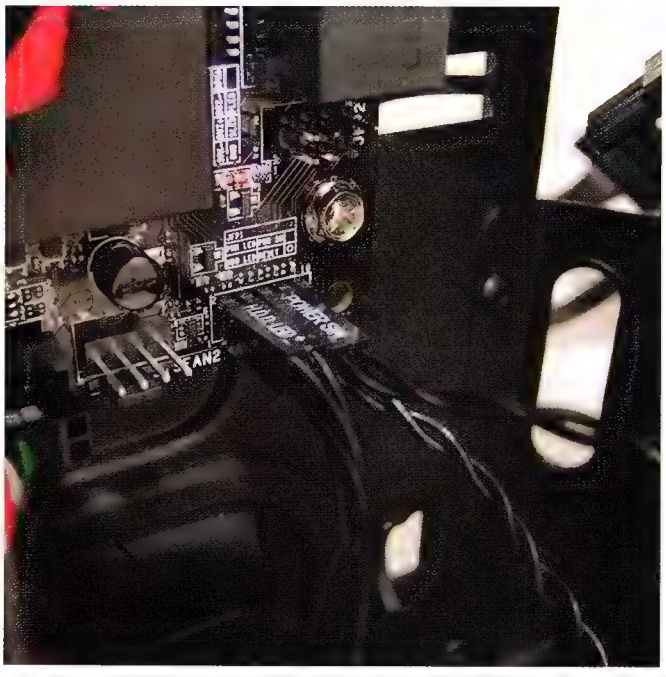
We'd recommend starting with the power supply, because it's a lot easier to get the bulky darn thing installed before you fix any other components in place. Get your PSU seated, making sure the intake fan is sucking from the vent in the base of the chassis, and screw it into the case from the rear. Now collect all the cables from the back of the PSU and make sure they're not cluttering up the space inside. You don't want to accidentally screw in the motherboard on top of anything.

6 SEAT THE MOTHERBOARD

So, yeah, it's now time to screw in the motherboard. Hopefully your chassis will have the copper risers already in place. If not, you need to attach those first. It's worth removing the CPU cooler from the motherboard before you do this, but you can leave the processor itself in place along with the memory when you're screwing it down. If you're using a water cooler, however, it might be worth checking that the radiator part will fit properly in place before finally seating the motherboard.

7 INSTALL SOME STORAGE

SSDs are at a stage where you can pick up a drive with enough capacity to fulfil pretty much all your needs without the need for an extra HDD to pick up the slack. This 1TB 840 EVO drive is all we need to start with. Our CM Storm Scout 2 comes with a 2.5-inch adapter tray. Screw your drive into the relevant area in your case and plug the SATA cable into the first SATA 6Gbps connector. You'll also need a SATA power connector from the PSU.



9 CHECK YOUR CABLES

Now it's time to start plugging everything back in. First things first though — get the chassis' controls and hubs plugged into the motherboard. We've often put a build together, forgotten this simple step and wondered why we couldn't power up. Again, your motherboard will have a key to show which front panel cable goes where. Plug in the control and lighting cables, as well as any USB 2.0 or 3.0 hubs and audio connectors.

8 FIT YOUR GRAPHICS CARD

We're getting mighty close to the end now, so it's time to slot in the sexiest component of the lot — your new graphics card. It's also probably the chunkiest of the components, after the PSU brick, which is why we've left it until towards the end of the build. Ensure it's seated firmly in the primary PCIe slot and screw it into the chassis to stop it from moving around or rattling. It's worth making sure there are no cables obstructing its fans.

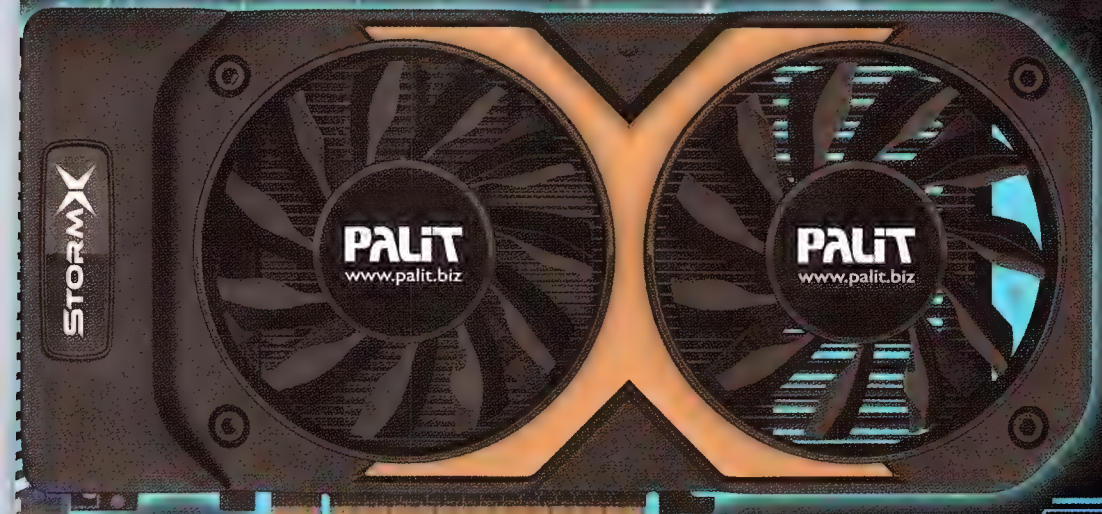
10 LET IT BREATHE

To ensure the best possible airflow in your case, route the largest cables around the back of the board. Plug in the motherboard and GPU power connectors, and then re-attach the CPU cooler, ensuring its fans and any water-cooling radiator are powered, too. It's worth leaving the sides off the case the first time you start up with the monitor and keyboard plugged in. That way you can quickly see whether any fans are obstructed or not powered. With any luck, all will be well and you will be ready to install your OS on your brand new custom build. ■

THE GREAT GEFORCE® GTX™ 750Ti STORMX DUAL

STORMX DUAL GEFORCE® GTX™ 750Ti

Enjoy the brand new StormX Dual series.
Maxwell Architecture-Lower Power and Great Performance



StormX Dual

Solid Capacitors

TURBOFAN BLADE
TurboFan Design

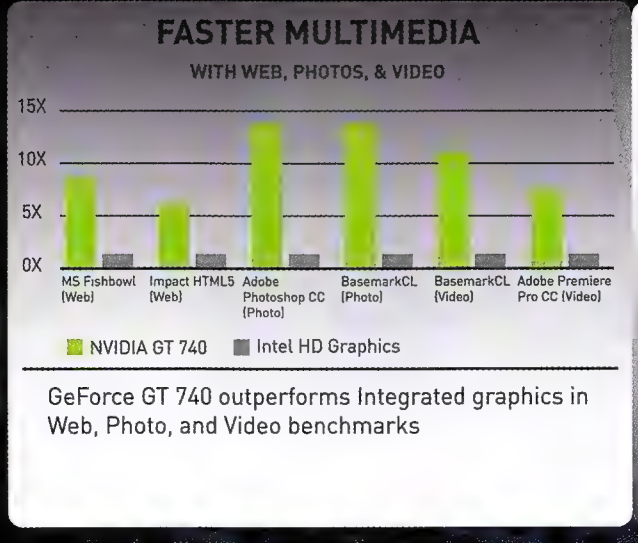
- Palit New StormX Dual thermal design
- 13% overclocking performance
- Maxwell architecture-lower power and great performance
- Advanced Power Saving GTX series.
- Double 8cm-TurboFan Blade design-optimized airflow
- Great Hardware Components

High quality Ferrite Core Chokes

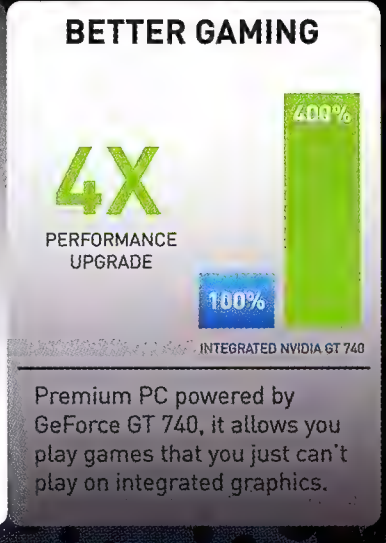
High efficiency PWM design with super low RDSIonI MOSFET

PREMIUM PC power by Palit GEFORCE® GT 740

Enjoy a rich multimedia experience and affordable PC gaming.



GeForce GT 740 outperforms Integrated graphics in Web, Photo, and Video benchmarks



Premium PC powered by GeForce GT 740, it allows you play games that you just can't play on integrated graphics.

PALIT®

NVIDIA

Transfer files to a new computer

Discover how to save heaps of time when moving files to your new PC.

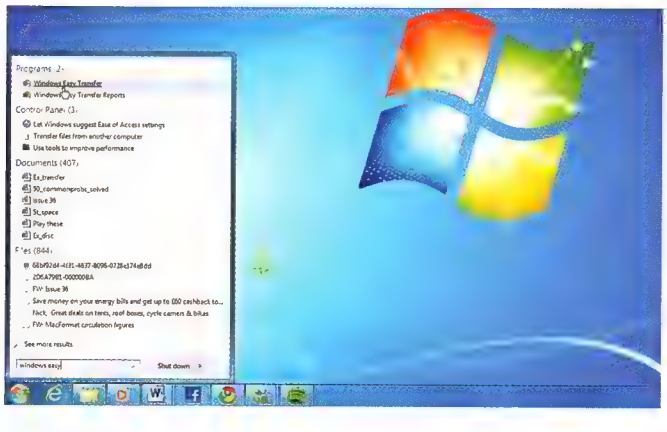
People often make life more difficult for themselves than they need to. They buy a new computer, then spend hours needlessly copying files across from their old one, folder by folder, tweaking the desktop so that it looks the same, and adding all their shortcuts to the menus.

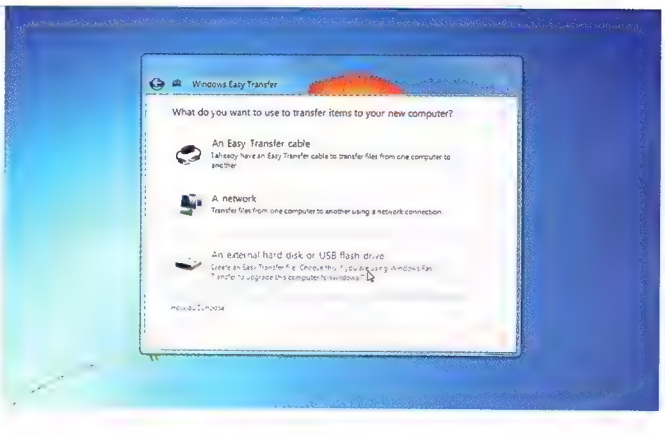
Sometimes you've just got to step in and lend a hand, and we've recommended to many a friend that they do the job with Windows Easy Transfer instead. It helps to migrate files and settings, such as photos, contacts and favourites, from one PC to a new one – so everything is set up and ready to use just like before.

Windows Easy Transfer is pre-installed in Windows 7 and 8. If you've got Vista or XP, don't worry because you can download and install it for free.

Move your data

Let Windows Easy Transfer do the hard work so you don't have to.



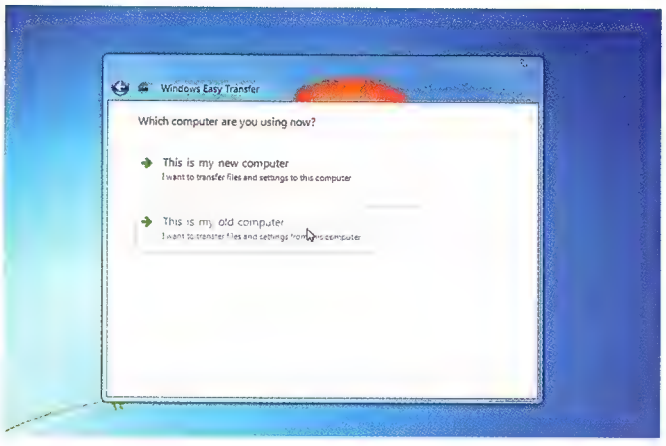

Windows Easy Transfer
What do you want to use to transfer items to your new computer?
An Easy Transfer cable
A network
An external hard disk or USB flash drive

1 FIND IT

To start transferring files from one Windows 7 or 8 computer to another, type `Windows Easy Transfer` into the search bar and hit Enter to open it. If you're transferring your files from a Windows Vista or Windows XP computer, you need to download and install Windows Easy Transfer from **tinyurl.com/y2o5wkr**.

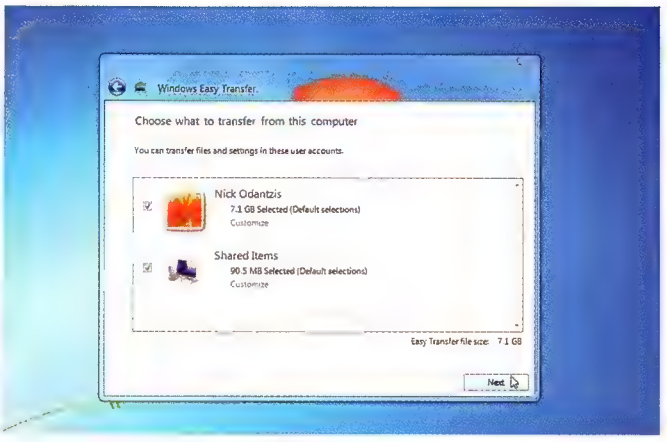
2 CHOOSE HOW TO TRANSFER

Once you've opened Windows Easy Transfer, click Next. The following screen asks you how you want to transfer items to your new computer. If you have an Easy Transfer cable, choose this option (visit **tinyurl.com/pwekmpx** to find out how to get one). If not, opt to use an external hard disk or USB flash drive, or transfer via a network.


Windows Easy Transfer
Which computer are you using now?
This is my new computer
I want to transfer files and settings to this computer
This is my old computer
I want to transfer files and settings from this computer

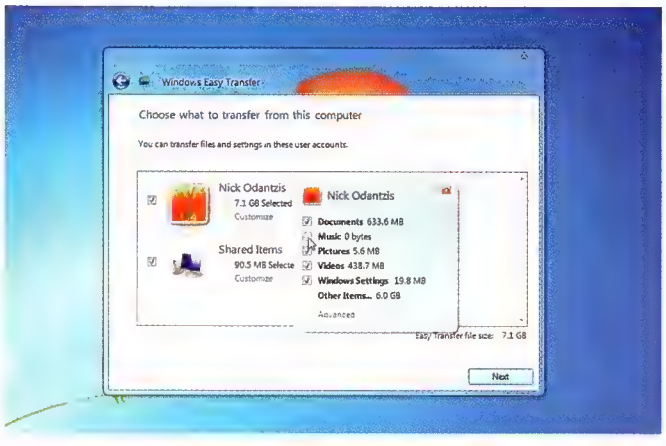
3 WHICH PC?

You're going to transfer your important files first, so you need to select 'This is my old computer' from the two options that appear. Windows now takes a good look through your hard drive to see what sort of items you can transfer to your new Windows computer. This takes a few moments, so be patient.



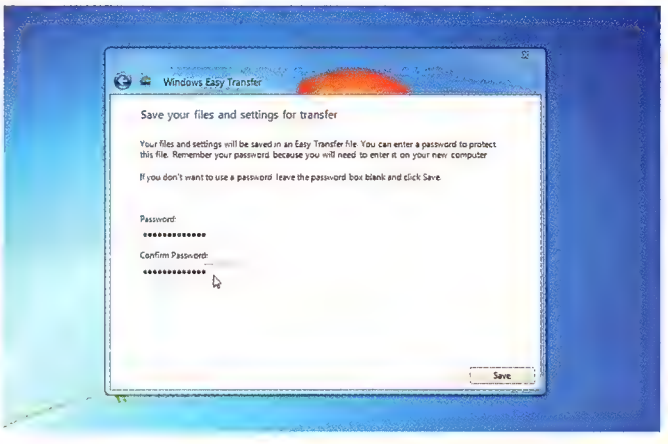
4 SELECT WHAT TO TRANSFER

If you're happy with everything Windows has found to transfer, click Next. The app tells you how big the files you're transferring are in the bottom right-hand side, so check there's enough space on your external drive if that's how you're going to transfer them. If the drive is too small, you need to deselect some files or folders.



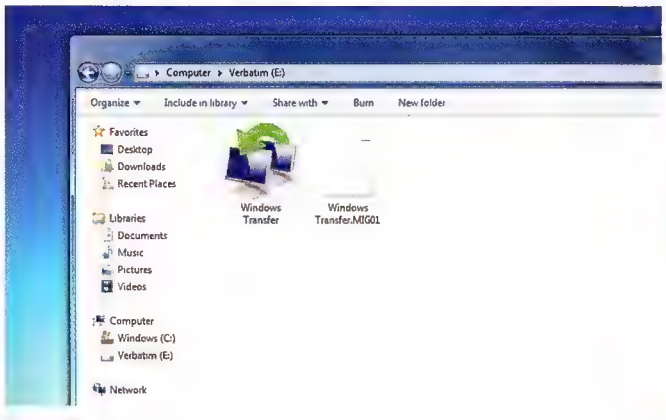
5 PICK AND CHOOSE

If you'd like to customise which files or settings Windows transfers, click on Customize underneath your old computer's name, and select or deselect folders to choose what you'd like to copy. To delve even deeper and further customise what you move across, click on 'Customize > Advanced', select more folders and then click Save.


Windows Easy Transfer
Save your files and settings for transfer
Your files and settings will be saved in an Easy Transfer file. You can enter a password to protect this file. Remember your password because you will need to enter it on your new computer.
If you don't want to use a password, leave the password box blank and click Save.
Password:
Confirm Password:
Save

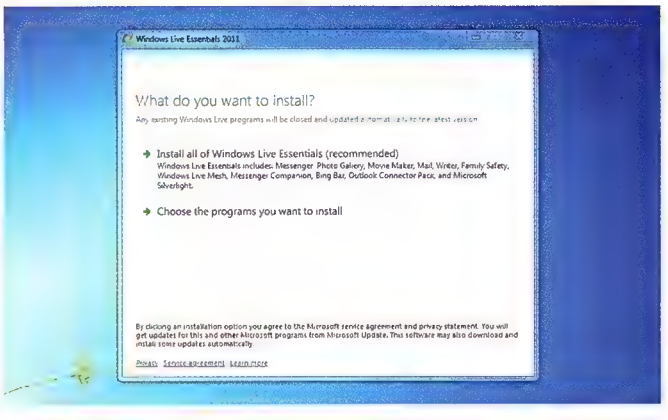
6 PROTECT AND SAVE

All your files and settings are saved in one file, which you can password-protect. This prevents anyone tampering with it before it's moved across to your new computer. Next, choose where to save the file — we saved it to a portable external drive. Saving can take a while depending on how big the file is, so do something else while you wait.



7 TRANSFER IT

Once the file has been saved, click Next, then Next again, followed by Close. Now turn on your new PC, plug in the external hard drive to which you copied the Windows Easy Transfer file, browse to it and double-click it. When prompted, enter the password, and on the next screen click Transfer. Your old items are moved over.


Windows Live Essentials 2011
What do you want to install?
Install all of Windows Live Essentials (recommended)
Windows Live Essentials includes: Messenger, Photo Gallery, Movie Maker, Mail, Writer, Family Safety, Windows Live Mesh, Messenger Companion, Bing Bar, Outlook Connector Pack, and Microsoft Silverlight.
Choose the programs you want to install
By clicking an installation option you agree to the Microsoft service agreement and privacy statement. You will get updates for this and other Microsoft programs from Microsoft Update. This software may also download and install some updates automatically.
Privacy Service agreement Learn more

8 FINISHING TOUCHES

You now have a new PC that looks like your old one, and all your files have been transferred to the hard drive, so there's little left to do except install your old programs. Click 'See a list of programs you might want to install' for a report of which ones you should consider installing, based on what you were using on your old computer. ■

Overclock your Intel Z97 PC

Squeezing serious speed from your K Series Core i5 or Core i7 is easier than you might think with a quick trip to the BIOS.

The latest Intel CPUs may not rock the world with outrageous new levels of overclocking headroom – that much we've already seen in our reviews of the first models – but they still have an awful lot to offer when overclocked.

So what's new and what's stayed the same when it comes to coaxing more clocks from Intel's 4th Gen Core CPUs? As before, only the K Series models – the Core i5-4690K and Core i7-4790K – offer fully unlocked CPU multipliers, so it's those chips we'll focus on.

Likewise, it's mainly the CPU multiplier you need to worry about. In fact, for quick and easy clocking, you can simply jump into the BIOS, knock the global CPU multiplier setting to 40 for a base core clockspeed of 4GHz and then boot and reboot, increasing the multiplier in single steps. Odds are you'll only have to do that five or six times to find your chip's basic limit, and that will give you about 80% of what it'll achieve with fine tuning.

The BIOS is easier to use and easier on the eye than ever before.

Another thing that hasn't changed is the baseclock. It's still 100MHz and, for the most part, it's still 'no-touchy'. That's not to say the baseclock isn't adjustable, it's just that the way Intel ties together the timing of its current CPUs means that bumping up the baseclock has a knock-on effect on all sorts of subsystems, such as the PCI Express bus. That means the whole thing falls over if you mess with the baseclock beyond a few percentage points. Handy when trying to squeeze out a few more MHz to break a record, but pretty irrelevant in all other scenarios.

However, there is one qualifier to that. For 4th-Gen Core, Intel introduced a new baseclock strap adjustment. It was first seen in the Sandy Bridge-E CPUs for the high-end LGA 2011 socket. The strap adjustment is basically a divider for the baseclock; it means you can choose from 100MHz, 125MHz or 166MHz baseclocks, while keeping the speeds of subsystems like the PCI Express buses and storage lanes at their standard spec.

Of course, it's the baseclock setting – combined with the CPU multiplier – that determines the ultimate clockspeed of your cores. The jumps of the baseclock strap are pretty coarse, and for most people, most of the time, they don't offer much advantage. If you're trying to squeeze the last few percentage points out, though, the feature gives you a few options.

As for how you go about all this, you have two basic choices. Some motherboard manufacturers offer Windows apps that give you access to most or all of these settings. It's a nice way of going about things and has the advantage of allowing you to tweak settings on the fly. That's good if, for instance, you want to run at standard clocks most of the time, but crank things up for video encoding or gaming.

The common denominator option is the BIOS, which tends to be nicer looking and more user friendly than it was in the bad old days. One final note: 4th and 5th-Gen Core chips tendsto have a bit more trouble with heat dissipation than ye olde 2nd and 3rd, so an upgraded cooler is well worth looking into. We'd go for a water cooler on grounds of effectiveness and minimal noise. A decent single-rad 120mm water cooler can be had for around $95, so it needn't break the bank, either.

Jargon buster

BASECLOCK STRAP
Don't get too excited, it's only available on the K Series chips and it's really only of interest to hardcore overclockers who are looking to squeeze out a few last percentage points because they can.

CPU MULTIPLIER
Your CPU's speed is a function of two things: the baseclock and the CPU multiplier. On Intel's K Series chips, the latter is unlocked, making for seriously simple overclocking – as we're about to explain.

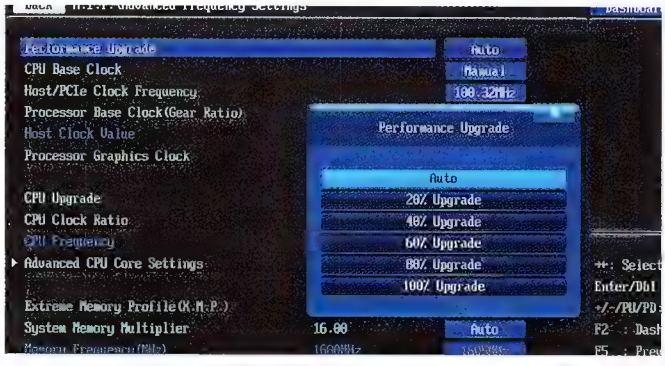
VCORE
This is the usual name for your CPU's core voltage, and for most purposes is the only voltage setting you really need to worry about.

Feeling the need for speed?

Have no fear — our Intel overclocking guide will show you how to get it.

1 CHILL OUT!

You won't get very far without a solid cooling solution that's properly screwed down. We advise a water-cooler for Haswell chips. A decent PSU is also essential for supplying quality current. Both of these components are transferable to new systems when you upgrade your rig, so they're well worth a little extra investment.



2 BIOS BASICS

First, get familiar with your BIOS basics and your system's default settings. Most motherboards let you jump back to optimised default settings, so it's not a disaster if you twiddle with something unknowingly. Having a good feel for the default settings will help you navigate all the options and settle on a nice, stable overclocked spec.

3 FULLY AUTOMATIC

Doing everything by hand is obviously the manlier option, but motherboards are increasingly good at doing the work for you. Unless you're going all out for the maximum overclocking, give the auto option a whirl – if it hits 4.5GHz, that's probably good enough. You can also use the auto setting to get a marker for the CPU voltage setting.

4 IT'S ALL ABOUT THE MULTIPLIER

After you've given the auto setting a whirl and the CPU voltage is dialled in, the next step is the CPU multiplier. As standard, the baseclock is set to 100MHz, so it's easy to calculate the end overclock from the multiplier. To start, we suggest you jump to 40 for a 4GHz overclock, then increase the action in single-digit multiplier steps from there.

5 THANKS FOR THE MEMORY

In the old days, mucking about with memory was critical. That was because bandwidth was at a premium and overclocking only made it worse, and because overclocking was mainly done via the baseclock and had a knock-on effect with memory. Neither of these now apply, so don't worry about it beyond the XMP settings.

6 STRIVE FOR STABILITY

Once you've got your hot new CPU overclocked, it's time to run a few benchmarks. Not only will this confirm that all is well in terms of performance (thermal throttling is a worry), it will also make sure your settings are actually stable. It's not unusual for an overclocked rig to boot just fine, but fall over under heavy loads. ■

Optimise your SSD

Discover how to squeeze the last drop of performance from a solid state drive.

The instant increase in performance you get from switching from a hard disk to a solid state drive is quite special. You don't notice an upgraded CPU in the same way (unless you're replacing a Pentium II), and as for RAM? Forget it.

No other component transforms your everyday computer use like an SSD, which is why making sure it's running as efficiently as possible is a worthwhile endeavour.

There's a mountain of advice out there from the internet, the IT guy in your office and the lady down the road in the tinfoil hat regarding proper maintenance of solid state drives, and often their insights are conflicting. Should you turn off the page file or not? Is Windows using the TRIM command correctly, or do you need an extra software layer? We're here to help.

READS AND WRITES

First, let's establish what it means to 'optimise' your SSD. Begin by forgetting those sequential read/write figures that manufacturers love to wheel out. They do so because a sequential write time of 500MB/s sounds really impressive, whereas a random write time of 24MB/s sounds bloody pedestrian.

Guess which type of task your disk completes most often? Correct, the random writes. You can check this for yourself by downloading Diskmon (**tinyurl.com/2hye58**) – a program that tracks every task your disk does as you go about your business for a few hours.

Maximising your random read and write times is a big part of SSD optimisation, but it's not the whole story. Flash memory performance degrades over time, so it's also important to ensure you're not thrashing your SSD unnecessarily. Windows 7 was designed before solid state became the norm, so by default it does a number of things that are either superfluous or potentially damaging to your storage. Windows 8 isn't without its anachronisms in this area, either.

There are three areas to focus on that'll help to optimise your disk: motherboard spec and BIOS settings are the starting point; tweaking your operating system is the main course; and third-party software programs are your dessert. Let's start with the nuts and bolts: getting your mobo and its BIOS to play nicely with your drive.

SATA STARTER

There's an excellent chance your SSD is SATA 3 compatible, which means its SATA port can throw data back and forth at a theoretical 6GB/s. It's therefore paramount to make sure your motherboard also supports this interface – ideally natively rather than using a third-party controller. It's common in cheaper P67/Z68 chipsets to only find a Marvell SATA 3 port on your mobo, and these really lower your performance ceiling. If you're wondering why you can't replicate the advertised synthetic benchmarks, this is probably the cause. On anything later than Intel's Z68 platform, there's a better chance of finding native SATA 3 ports, and boards built around AMD's 9-series chipset regularly feature as many as six. Now the first potential bottleneck is cleared, enter your BIOS and check you're running the disk in AHCI mode rather than IDE. Of these two standards, only the former enables SATA 3 functionality.

Now that we're out of the BIOS and into Windows, it's gentlemanly conduct to check that your chipset drivers are up to date. Most mobo manufacturers will host a page

SSDs create a lot of garbage.

What is TRIM, anyway?

Solid state devices can't write new data on to blocks that already contain old data. They must first wipe that cell clean, then perform the write (the read-erase-modify-write cycle), and the more that happens, the more performance degrades over time. The TRIM command works a bit like the Recycle Bin on your desktop; the SSD marks data as ready for deletion, and TRIM confirms that it's OK to empty the Recycle Bin and flush the data away for good. The more unused data is flushed away, the likelier it is that the memory controller in your SSD will find unoccupied cells to write to, minimising disk wear. That process is known as garbage collection.

TRIM is initialised by your OS. That means your SSD can't force its will upon your system — instead, the system must support the TRIM command in the first place. In the very early days of consumer SSD usage, none did. Windows 7 made the jump in 2009, though even today it only supports TRIM in AHCI mode, not PCIe.

containing links to all the relevant firmware and drivers, and there's a chance the latest driver increases performance. After the restart, you'll be taking on Windows, tweaking it like... You know what? Let's not finish that one. Suffice to say, changes will be made.

Windows does an assortment of background tasks that are unnecessary for SSD owners – scheduling disk defrags, creating system restore points, constantly re-scanning data clusters so it can return search results quicker for you. It's time to turn all that off, and give your drive some peace and quiet.

Turning off defragmentation is a biggie. You don't need to defrag an SSD, and the only voice that'll tell you otherwise is that of someone shilling SSD defrag software. An SSD's memory controller writes to NAND cells across several flash modules at a time, writing data literally all over the place. On a mechanical drive, that would be a problem, since its moving parts take time to scan the disk. Flash memory controllers are more than up to the task of retrieving the data across several modules – you're not losing a drop of performance.

With your BIOS and OS now tailored to your SSD's needs, you have created an environment in which it can perform random read/write tasks as fast as possible but, crucially, only when those tasks are necessary. It's win-win: lightning performance when you need it, with the longest possible lifespan. If you want to take it even further, there are options, but by getting Windows in order and eliminating the possibility of a hardware bottleneck, you've done your drive a solid.

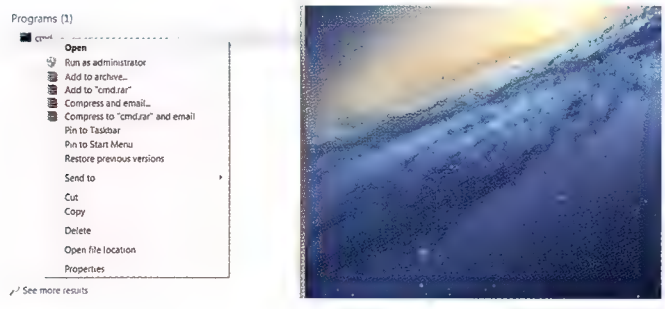
Jargon buster

NAND
A type of Flash memory in which every bit of data is stored on transistors known as floating gates.

WRITE AMPLIFICATION
Unnecessary writes that are performed by an SSD's memory controller when it comes across occupied NAND cells.

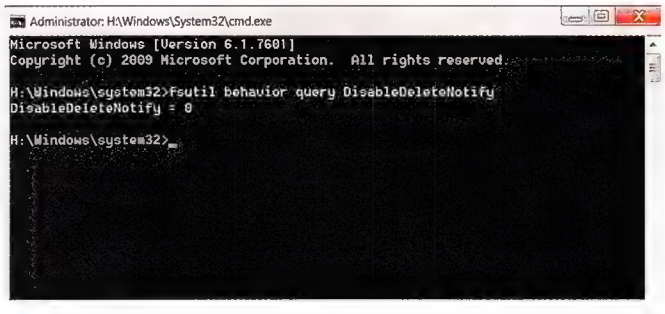
Check your TRIM is working properly

Minimise write amplification by making sure unused data is being flushed.



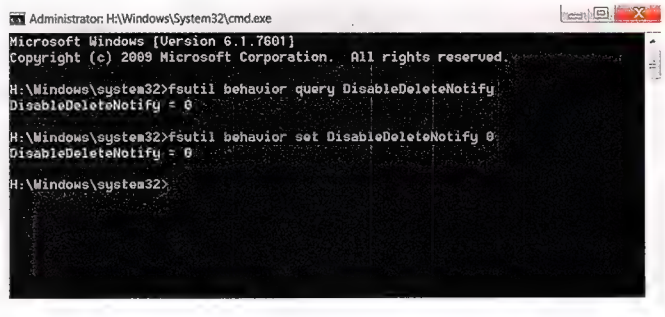
1 OPEN A PROMPT

There are programs like Intel's Toolbox that let you manually TRIM your drive, but you need to make sure Windows supports the command in the first place. To do so, start a command prompt as an administrator by searching for cmd in Start search, right-clicking on the program and selecting 'Run as administrator.' Got a prompt window? Good.



2 QUICK QUERY

Before telling Windows whether we want TRIM on or off, we need to know whether it's running already. Type `fsutil behavior query DisableDeleteNotify` and hit Enter. This only works if you're running with admin privileges, mind. If you are, you'll see a zero or a one. Zero is good — it means TRIM is already working. One means it isn't, but we're about to fix that.



3 ACTIVATE TRIM

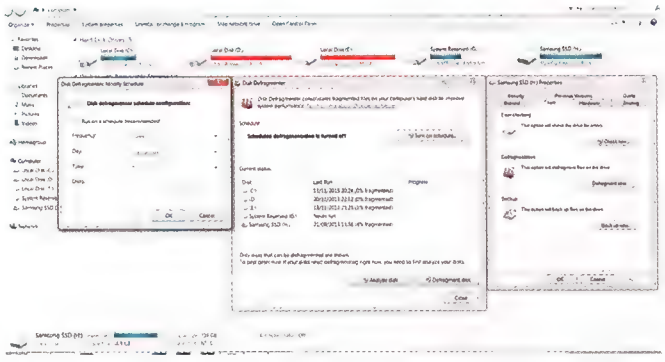
You're about to tell Windows to change one to zero, so in the same window, enter `fsutil behavior set DisableDeleteNotify 0`. You're setting rather than querying this time, and voilà: the TRIM command is now enabled in your Windows install. Just try not to think about all the write amplification that's been going on right under your nose until now.

Disable unnecessary Windows settings

No more needless write tasks with these handy tweaks.

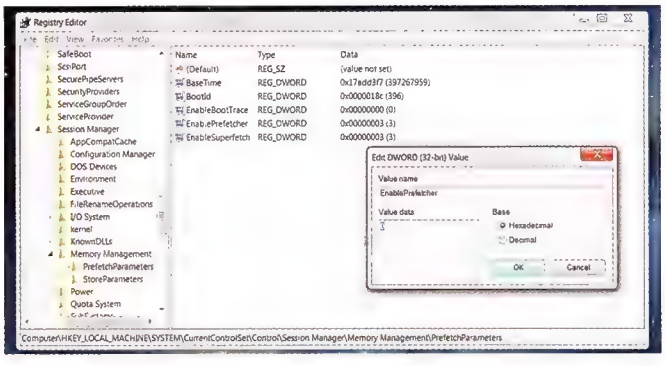
1 DISABLE INDEXING

Let's start by disabling drive indexing, which does nothing for your SSD's response time, but increases writes. From My Computer, right-click on your drive and hit Properties. At the very bottom is a tickbox that says 'Allow files on this drive to have contents indexed'. Untick it. Hit 'Ignore all' on the error message and wait a moment for the process to complete.



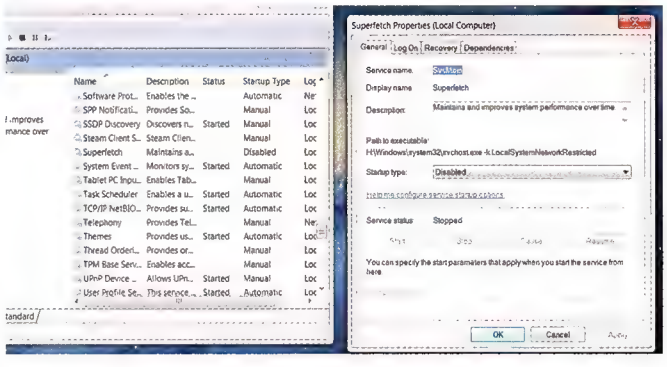
2 DON'T DEFRAG

While we're in the neighbourhood, stay in the Properties window and select the Tools tab, then hit the 'Defragment now' button. We're not going to actually run a defrag, now or ever; it does nothing to improve performance and thrashes your drive for no reason. Instead, select 'defragment schedule' and then untick any schedules lurking within. That's a load off your SSD's plate.



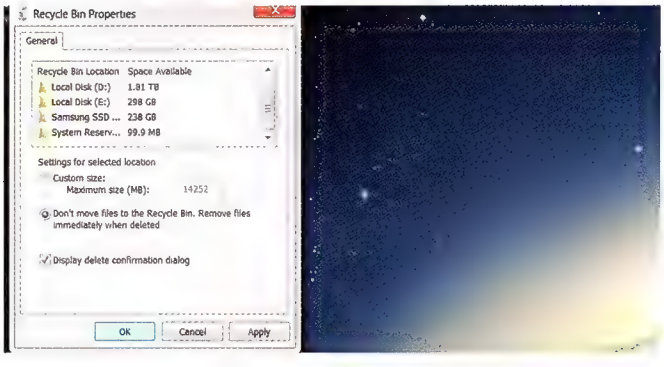
3 GIVE IT A REST

Next on the chopping block are prefetch and superfetch – processes designed to speed up search results by, yes, constantly thrashing your storage. In the Start search bar, type `regedit`, and when the registry editor opens, find the following file path: HKEY_LOCAL_MACHINE\SYSTEM\ CurrentControlSet\Control\ SessionManager\Memory Management\PrefetchParameters.



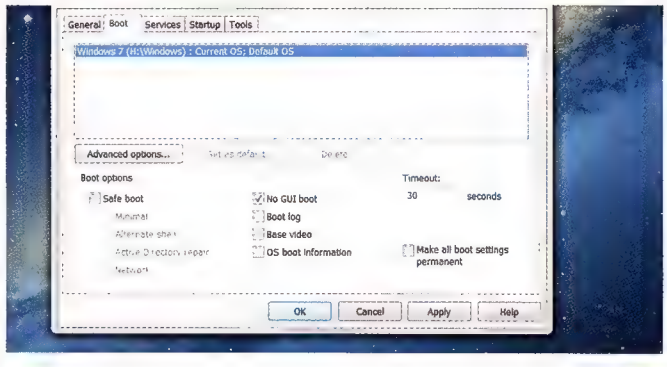
4 ABANDON FETCH

Now right-click on 'superfetch' and 'prefetch' to bring up their modify windows, then change their values to 0. You'll need to do a restart for the changes to take effect. Once that's done, type `services.msc` into the Start search bar, then find both superfetch and Windows search and use their drop-down menus to set them to 'Disabled'. So long, super-thrasher.



5 TRASH THE BIN

If you're feeling brave, you can disable the Recycle Bin, which helps the TRIM command to do its thing and keeps the maximum possible disk space free. Just don't come crying to us if you delete something important. Right-click the Recycle Bin, then hit Properties, select your SSD and hit 'Don't move files to the Recycle Bin'.

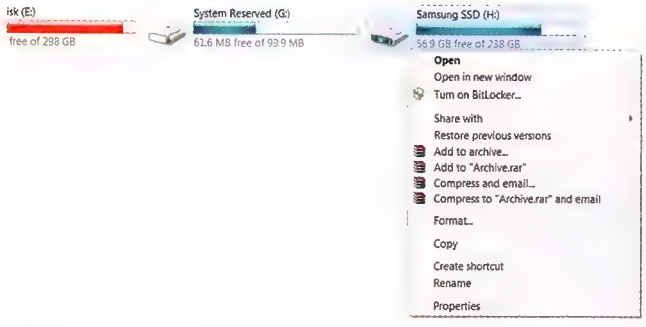


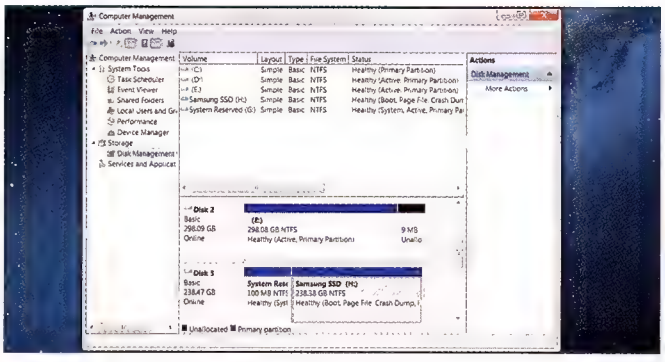
6 NO FRILLS

With Windows no longer beating your SSD like it's wearing a bow tie on its first day of school, all that's left is to boost your startup time. Type `msconfig` into Start search bar, then in the Boot tab, tick 'No GUI boot' to disable the Windows graphic and cut seconds off your boot time. Untick any unwelcome programs in the 'Startup' tab.

Create an over-provisioning partition

The closest you can get to overclocking your storage space.



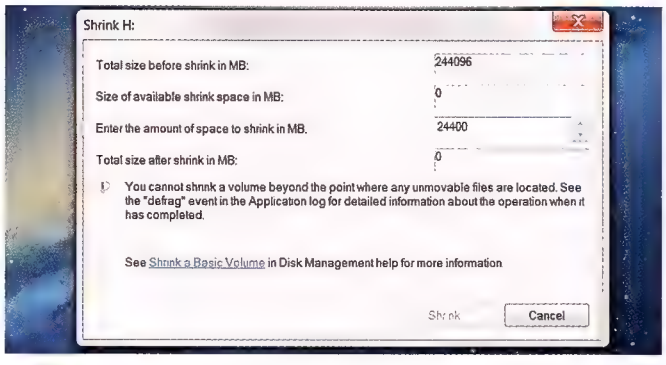


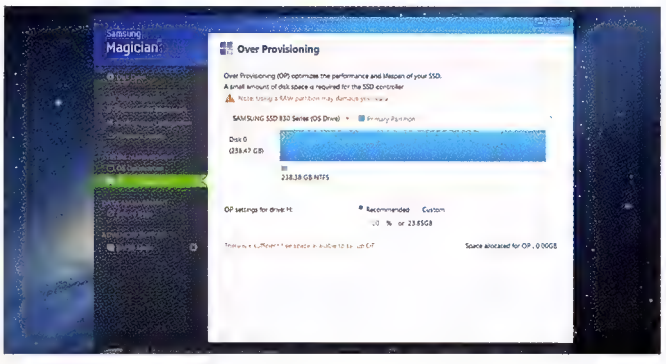
1 WIPE YOUR DRIVE

Setting aside some raw disk space in a partition can really boost the efficiency of your solid-state drive, but there's a catch: we do mean raw disk space, so you'll need to set this up on a completely wiped drive while running your OS on a separate drive. First step, then: format your SSD. Good night, sweet Willy Wonka meme JPG collection.

2 DO IT YOURSELF

If your drive manufacturer doesn't have a program that'll set up over-provisioning, you can work your way around it by right-clicking on 'My Computer' and opening the 'Manage' window, then 'Disk management'. You won't be able to shrink a volume with data on it, because SSDs have a scattergun approach to writing data and Windows simply won't be able to find a chunk of clean space.


Shrink H:
Total size before shrink in MB:
244096
Size of available shrink space in MB:
0
Enter the amount of space to shrink in MB:
24400
Total size after shrink in MB:
0
You cannot shrink a volume beyond the point where any unmovable files are located. See the "defrag" event in the Application log for detailed information about the operation when it has completed.
See Shrink a Basic Volume in Disk Management help for more information
Shrink
Cancel



3 HONEY, I SHRUNK THE VOLUME

Select your freshly formatted drive, right-click and hit 'Shrink volume'. Here you can set the over-provisioning space manually in MB. We recommend at least 10% to see changes that'll show up in benchmarks. The OP space you're about to create is reversible with another format, but make sure you don't leave yourself wanting for space. When you're sure, press 'Shrink'.

4 THE EASY WAY

If you do have some software provided by your SSD manufacturer, it's a bit simpler (though still requires a formatted drive). Samsung's Magician has an over-provisioning tab that allows one-click setup. You can fiddle with the reserved area size first, of course. Once it's set, you can also enter this menu to clear the over-provisioning area again and fill the space with virtual tat.

One step beyond

You can't yet overclock a solid -state drive, but you can boost its performance through other means. The most effective of these is over-provisioning, in which you set aside a certain amount of storage space (usually a minimum of 10 per cent) as a buffer for the memory controller. Think of it like a work bench. Setting up a partition for over-provisioning requires software from your SSD manufacturer like Samsung's Magician, and while the results grow significantly better the more space you set aside, you're also trading writable disk space for performance. As such, it's only a viable option for 320GB drives or bigger. If you're feeling lazy or don't want to commit to a partition, simply keeping a big chunk of free space (at least 10 to 20%) will help, too.

It all comes down to write-amplification — when the memory controller tries to write on a NAND cell that already has data occupying it, it must first erase that data, rewrite it somewhere else, then perform the original write task. We've already covered how excess writing can be filed under 'a bad thing', but whether you're over-provisioning or simply running plenty of free space, you're increasing the probability that the memory controller will come across a free NAND cell, and thus will only have a single write operation to perform.

It's worth exploring all the features in the manufacturer's software suite for your drive. We'll touch on Samsung again since it's ahead of the curve with Magician, which includes RAPID mode — an optimised caching method that really yields increased random write speeds. Surprisingly, features like this can be patched in, so it's worth keeping your software up to date. If you've tried everything in this guide, your drive will be operating quicker than a hummingbird after its third cup of coffee. You just made its life a little easier, and now it's going to return the favour.

Getting past the POST

Here's the *APC* guide to digging yourself out of the hole and getting your PC properly powered up.

DANG, IT'S DEAD. You've pressed the power button and your PC's got little sign of life, let alone an operating system. You may have some text from the BIOS flash past, or a blue screen, or a blank screen. You may have complete silence or a flurry of beeping noises and frantic fans. Never mind driver problems, this is more fundamental than that. Your box has fallen at the first fence. The Power-On Self Test (POST) has bombed. Here's how to fix it.

ARE YOU ALL PLUGGED IN?

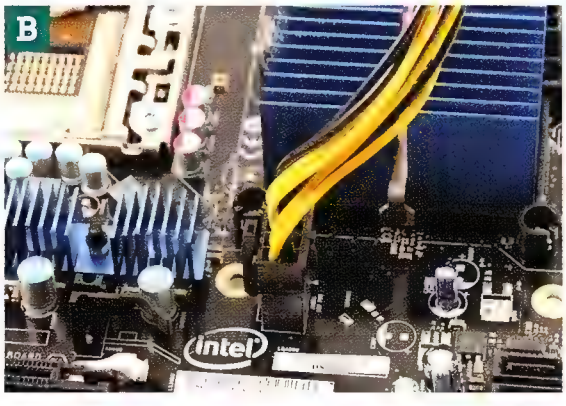
Keep it simple and start with the basics. Never underestimate how easy it is to make a fundamental error.

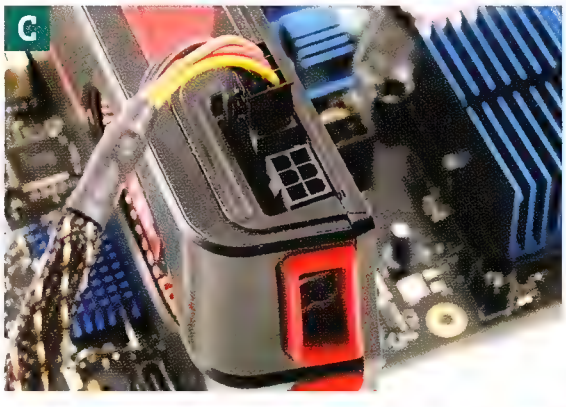
Is it really on? On the back of your PSU there is probably an innocuous-looking black rocker switch (**IMAGE A**). This turns it on. Often never touched in everyday use, it's possible to forget about it and start messing with the panel switches and worrying about dead components when all the time you haven't switched on the juice, especially on an unfamiliar PSU. If this still fails, try replacing the power cable – you may have a faulty one – even if that's fairly unlikely.

Next check the processor power (**IMAGE B**). Chips get their own power supply, and it's ridiculously easy to forget to plug this bit in, which leads to a seemingly dead system. It'll use either an 8-pin block or a 4-pin block. Often the power supply lead splits the 8-pin into two 4-pins to be compatible with both. It's the socket right next to your processor, often labelled "12v ATX." If in doubt then it's in the manual (which you've read, haven't you?). Another easy miss is the power for your CPU cooler. Some boards refuse to do anything unless they detect this plugged in.

Now for video power. Nothing on the monitor? Another easily overlooked connection is the graphics card's power supply. They can be hungry things, and only the gutless kind can run off the socket power alone, a mere 75W maximum. The exact requirements depend on the beefiness of the card. There are either one or two 6-pin blocks and/or an 8-pin block. Just make sure they're all filled. It's best to use cables directly from the PSU rather than adapters. Check you've no loose wires in the blocks, and don't force it, they only go in one way (**IMAGE C**).

Finally, give the front panel switches a once over. They're fiddly little cables that are easily missed. The polarity of the reset and power switches isn't important. If your activity lights fail to light, try reversing the connection. Disconnect the reset switch if you suspect a short (either not booting, or endless booting). You can also fire a system manually by shorting the power pins with a small metallic object if you suspect your case switch, but make sure you've properly identified them.





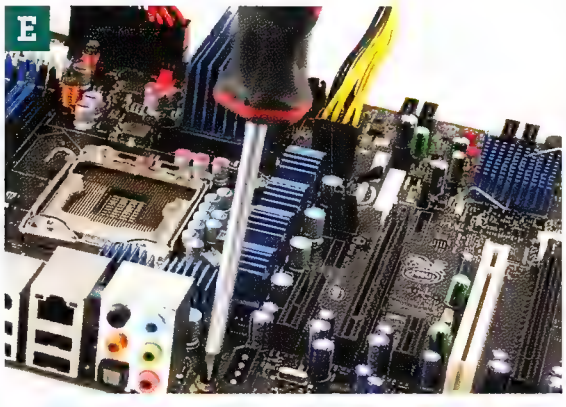
OK, SO IT'S ALL PLUGGED IN. WHAT'S NEXT?

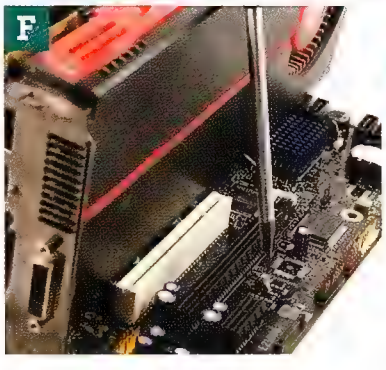
A poorly seated video card is a common error. The cards can take considerable force to get them properly seated, more than a novice builder may be expecting (**IMAGE D**). This can be worrying, as flexing your board is really not a good idea. Make sure the board is fully supported with stand-off posts before applying pressure. Many boards have securing clips for the card – if you can't get these to click into place neatly, then the card needs pushing down further. Try removing and re-seating if the angle is at all crooked. Be firm and gentle at the same time (yes, we know this is impossible, but you know what we mean).

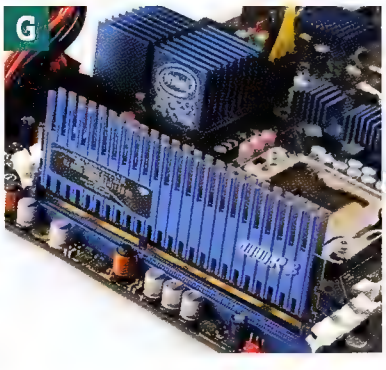
Another potential issue could be unwanted shorts. If an electrical conductor touches your board then it can cause a short circuit on the fine network of tracks, which is guaranteed to cause trouble. Check the small posts that the board sits on. Did you install them all in the correct places? There is no standard pattern, meaning it's easy to get one of them in the wrong place, especially as you won't see it from the top either. A misplaced one can easily cause a short circuit on exposed soldering (**IMAGE E**).

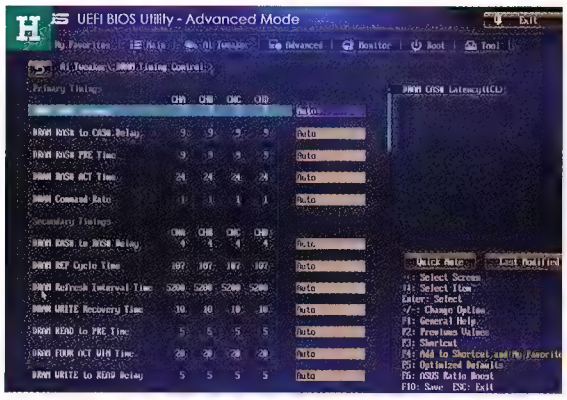
Did you drop a screw in there? It's easily done (**IMAGE F**). Retrieve everything you drop straight away in case you forget. Are there any wires touching the board which may have worn insulation? It's good practice to have all wires routed well away from the board, especially underneath, which has sharp soldered connections that can cut into wires. Many cases have a tray under the board to keep wires out of such trouble.

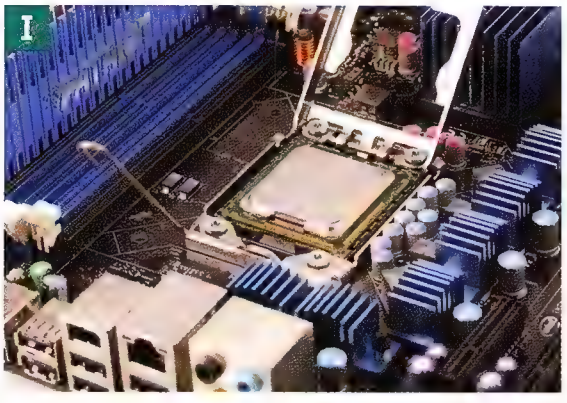
It's worth checking your memory modules are all fully seated, with the securing clips in place (**IMAGE G**). This can take more force than you might expect. Are they in the right slots? Some boards want the slots used in a strict order, others aren't fussy. Check the manual to make sure you've filled them in the right order as wrongly configured RAM is a common cause of dead boxes. It must match the board and processor. Try booting with a single stick of RAM, or one pair for coupled systems. You may have either a faulty RAM socket, or stick, so mix it about to pin it down.











Potentially, the issue is with the memory speed. If it can boot with at least one stick of RAM, then enable the XMP (Extreme Memory Profile, basically factory-approved overclocking) in the BIOS if the board supports it, or manually set memory speeds in the BIOS to match your stick's specs. If you have sticks rated at a higher voltage than the default settings allow, it can cause stability problems. On some boards, leaving it on "Auto" won't supply enough juice (**IMAGE H**).

Now check your processor is seated cleanly, flat, and the right way around (**IMAGE I**). These days it's hard to get the processor in the wrong way around – it's physically impossible for most. There's a visual indicator on the chip (a little arrow or similar). The socket will have the same indicator, or will be obviously not symmetrical. This is one bit of hardware where undue force should never be used as we don't want a bent pin or a borked socket. Pins can be coaxed back to vertical, very, very carefully. But if it breaks, you're stuffed.

YOU'VE COVERED THE OBVIOUS BASES, NOW WHAT?

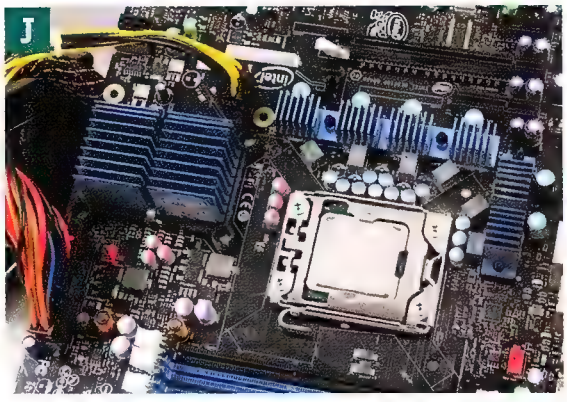
Your processor cooler can look OK to the eye, but it needs to be firmly in place and completely flush, otherwise the processor will overheat in very short order. Are all of the connectors snug and the cooler level? Did you put a (tiny) bit of thermal paste on? The surface between the top of the chip and your

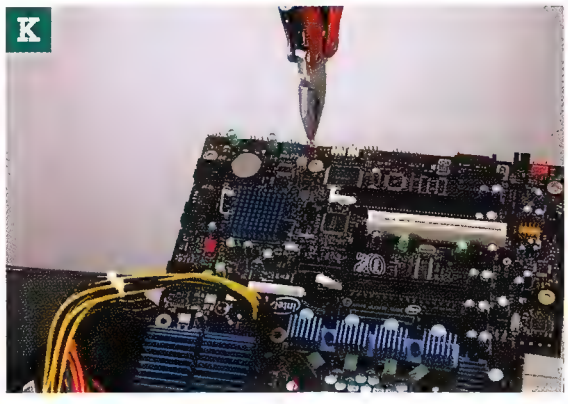
cooler needs to be good and true – sorry, but there's no "that looks good enough" here. The motherboard's thermal cut-out will trigger if it detects the temperature going through the roof. This may only take seconds.

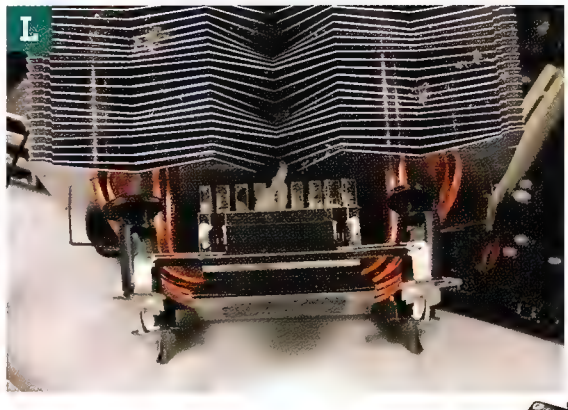
Clearing the BIOS is not to be considered too early as it will wipe useful information. But resetting the CMOS can fix some settings woes. The simple way is to go into the BIOS and restore the factory settings. The exact wording varies, "Clear BIOS," "Reset to Default," or similar. Not a lot of help on a system that's dead before you can get into the BIOS setup. Most boards have a jumper or DIP switch that will reset the CMOS (see that manual). Once cleared, your BIOS will re-detect all your hardware on booting, which may clear an overlooked incompatibility (**IMAGE J**).

Does everything appear to fire but the chip fan goes mental and then the whole system locks up? It could be processor cooling. Assuming your cooler is fitted properly, next suspect a restricted airflow, hence the fan running on maximum. Often it's an accumulation of dust deep inside the cooler, sitting between the fan and lodged in the cooling fins (**IMAGE K**). Or you may have hair wrapped around the fan itself, causing it to struggle. A fine pair of tweezers or a more thorough disassembly will put things right. If your rig sits on the floor and gets heavy use, this could be a reoccurring and common woe.

If you've a board with layers of dust and grime, you may have collected dielectric material, or the scum may be acting as a blanket of insulation (**IMAGE L**). Blowing is best, using your mouth, an air duster, or hairdryer (not too hot). Use a soft brush on more stubborn bits. If it's really grubby, you have the death or glory option of washing it in water (yes, really). Remove any CMOS battery and dip into the wet stuff (some espouse special solvents, but clean water leaves very little residue). Be very gentle and leave to dry, days not hours (a gentle blow-dry will help). Obviously it must be totally dry before running any power. If it works, glory. If not, tough – it's totally dead now. ■







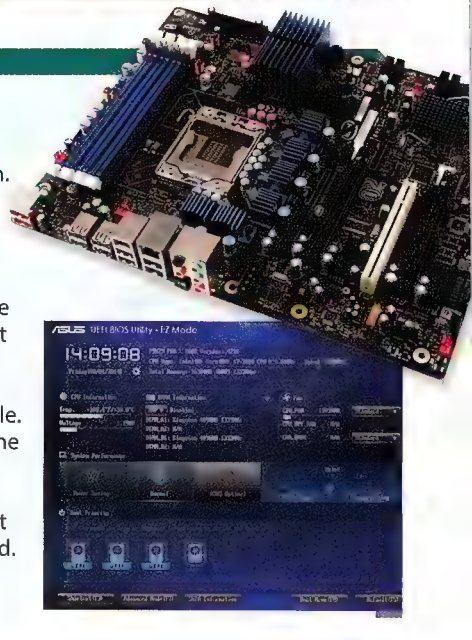
Beeping beeps

If your box is beeping, it's trying to tell you something. To hear these tones you used to need a system speaker. Unlike your regular sound system, a system speaker is separate and specifically for error codes, but we haven't seen one of those for years, as boards now have their own beep-maker.

IBM set out the original set of beep codes. One long beep and two short, for example, means it can't find a working graphics card. BIOS makers have since added more error codes, but there's no standard for what each one means. There are some consistencies (small numbers of short beeps are mostly memory errors), but there are also enough inconsistencies for it to annoyingly require specific documentation.

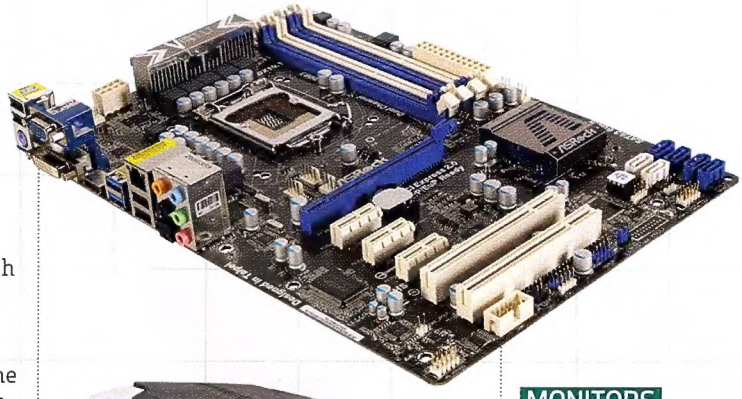
If your system beeps, however, it means we have a clue, and to the manual we go, or a working Internet connection (search for "POST error codes"—the top articles are all fairly good, especially the TechNick one). Once you've located the source, remove and re-seat the offending hardware and try again. If it's a powered component, check the power is plugged in. Possibly try a different power cable. Try swapping things around as described in the main text if it's a memory error.

While the error codes are a decent pointer, they give no idea as to the exact problem — it may be a seating problem or it may be trashed. But they're a huge help.



Jargon buster

Not sure what some terms mean? Here's a handy dictionary of what you need to know.



MOTHERBOARDS

CHIPSET> The combination of processor socket and interface chips that connect the CPU to the motherboard. Most system features are built into the CPU or the chipset, and so it defines performance and such things as SATA 6Gbps support for the rest of the PC.

ATX> A set of standards that define the size of a motherboard and the position of its fixings. Without this, there'd be no guarantee the motherboard would fit in your case or even have screwholes in the right place. Subsets include the smaller mini-ATX and micro-ATX, which sacrifice expansion slots for size.

PCI EXPRESS> The bus between the chipset and the expansion slots. The older PCI standard has now been phased out from most Intel motherboards. Bigger slots contain more lanes and are described as multiples – a standard graphics card requires a sixteen lane (16xPCI-E) slot.

PROCESSORS

SOCKET > How the processor is attached and then clipped firmly to the motherboard.

MANUFACTURING PROCESS > Measured by the size of components in an integrated chip, which are tiny – thousands of times smaller than the width of a hair.

HASWELL > Internal codename for Intel's 'fourth generation Core processors'. We often refer to processors bytheir codenames in the pages of APC.

PILEDRIVER > AMD's architecture for their current FX processors. The A-series is based on the Kaveri architecture

RAM

DIMM > Dual In-line Memory Module, the long thin circuit boards which are used to mount RAM chips into your PC.

MHZ > Megahertz, a measure of clock speed, which governs all the data transfers in your PC by moving electrons round in sync with each other.

CAS > Column Access Strobe, the regular pulse which reads information from the columns of bits on a memory chip. The CAS latency is the number of clock cycles it takes to retrieve data from the array, so the lower the better.

MONITORS

CRT > Cathode Ray Tube. The old analogue screens, drawn on by the firing of internal electron guns.

LCD > Liquid Crystal Display. A monochrome layer of liquid crystals that block or allow light to pass through individual sites.

LED > Light Emitting Diode. Low power lighting used in newer LCD screens to reduce running costs.

DISPLAY RATIO > The length of a screen compared to its height. Common ratios are 4:3 (old fashioned CRT and iPad), 16:10 (PC widescreen, now rare), and 16:9 (widescreen TV sizes such as 720p and 1080p HD).

CASES

ATX> The size designation for a motherboard and case. Make sure both are the same or else they won't fit together properly.

5.25/3.5/2.5-INCH> The three standard sizes for internal drives. Optical drives are always the larger 5.25-inch design, while hard drives are usually 3.5-inch. Some cases now have fittings for laptop drives (2.5-inch) since that's the size of a common SSD.

SECC> Steel, Electroplated, Cold rolled, Coil. The most common material used in case design. It's the stuff that gives you static shocks while you build your PC.

SSDS

TRIM> Most modern operating systems support TRIM, a feature of SSDs that instructs them to fully erase blocks of deleted data in the background when they aren't being used.

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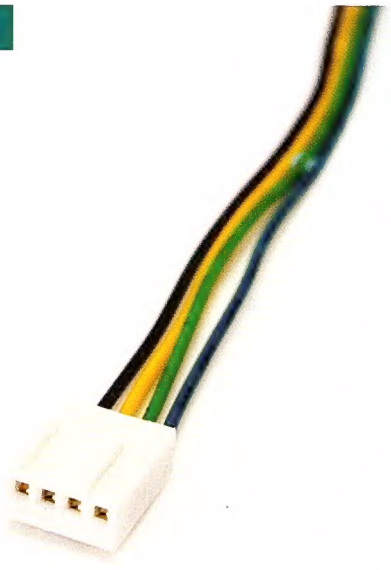

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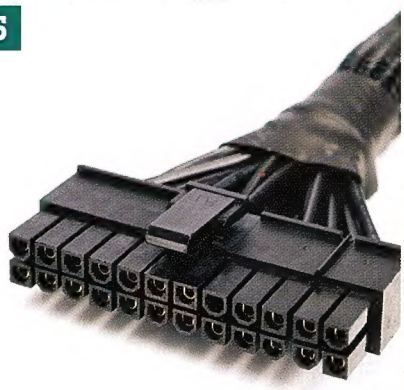

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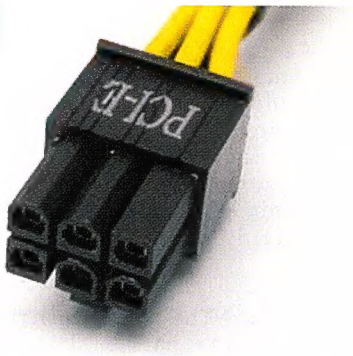

WRITE LONGEVITY > All flash memory has a limited lifespan, and will wear out after a certain number of writes. Current SSDs have an MTBF (Mean Time Before Failure) of around 2,000,000 hours and are no more likely to fail than a normal hard drive would.

SATA III > The latest specification for hard drive-to-motherboard interfaces is SATA III, capable of 6GB/s.

3D GRAPHICS CARDS

GK1xx> The code numbers for the microarchitectures used by Nvidia's current 700-series graphics. The GTX 770 uses the GK104 core, for example, while the 780 is based on GK110.

BATTLEFIELD 3 ULTRA MODE > Has become the de facto way of measuring really demanding game graphics. And it's not that demanding.

PCI EXPRESS 3.0 > Newer motherboards and graphics cards support this. It's only important if you're running more than one graphics card, as it means you can have two 16 lane slots working at full speed at once.

IMAGE QUALITY > Settings such as shadows, high dynamic range, motion blur and high resolution textures that you can turn off to make games go faster.

CABLE GUIDE

1. FAN HEADERS > The CPU fan runs off the motherboard via this four-pin connector. Case fans can use similar, or plug directly into the PSU.

2. SATA CABLES > These transfer data between drives and the motherboard. The L-shaped fitting means they only go one way round.

3. SATA POWER > Similar in shape but larger in size to the data cable, these run from the power supply to the storage drives.

4. FRONT PANEL CONNECTORS > These thin connectors attach directly to upright pins on the motherboard. See your manual for the layout.

5. 24-PIN ATX CABLE > The main power cable that plugs into the motherboard. The last four plugs are detachable for older 20-pin designs.

6. PCI-E CONNECTORS > Not to be confused with the eight- pin CPU power line, these six- or eight-pin fittings are clearly labelled for the GPU only.

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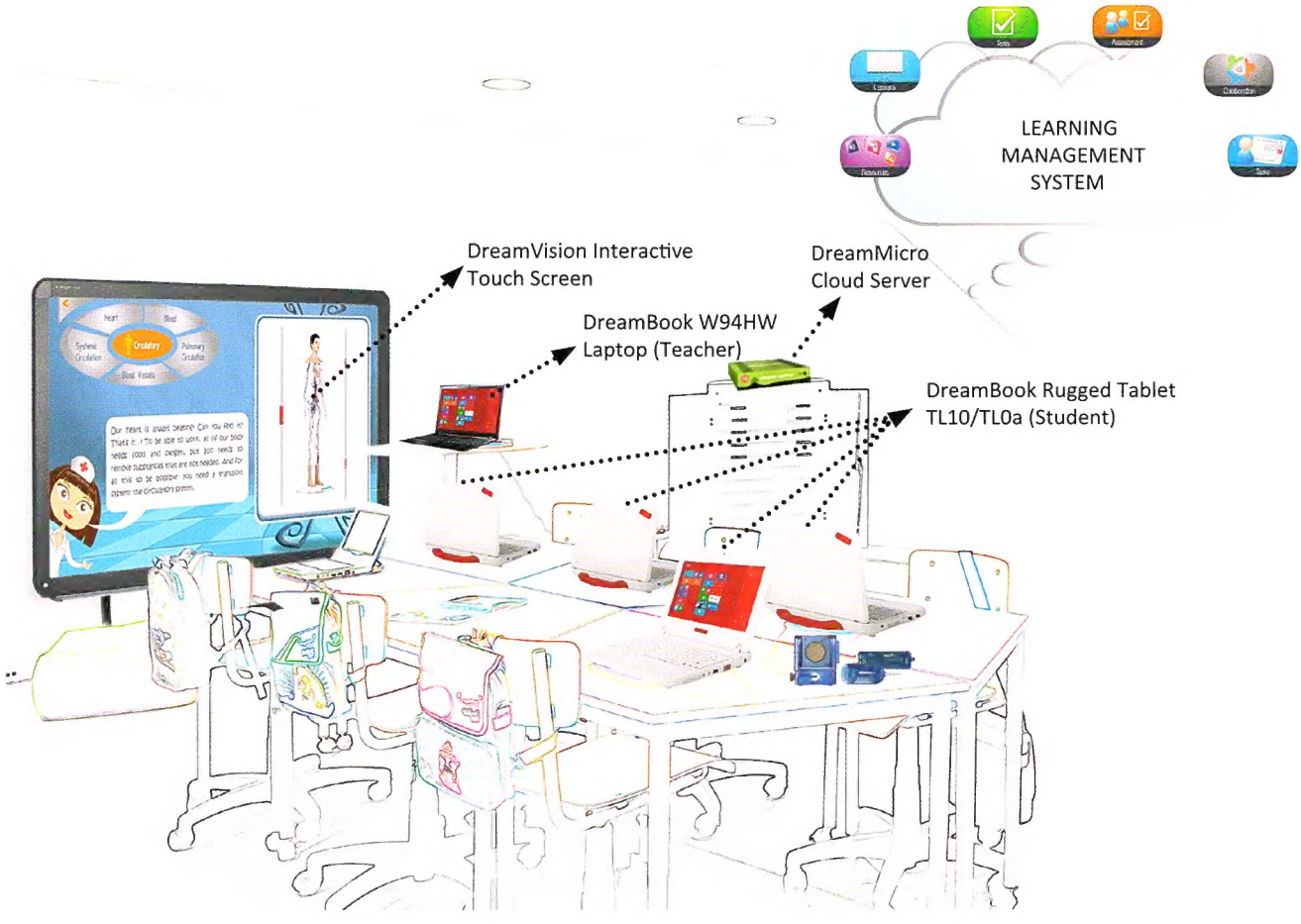

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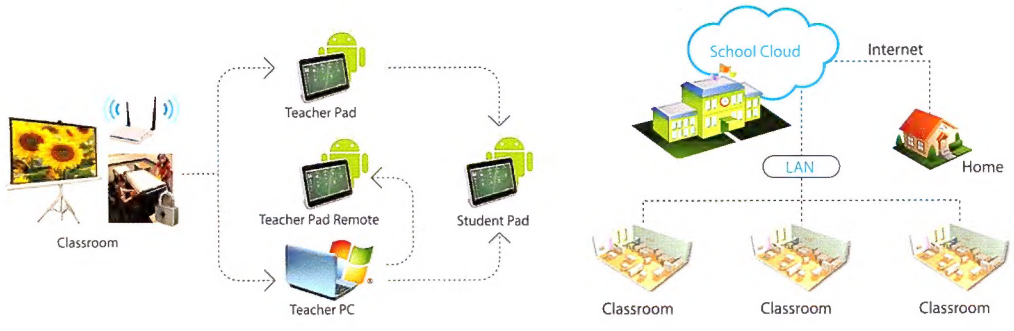

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